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H. G. Morgan

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III.

JANUARY, 1905.

Part 1.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

C O N T E N T S :

	PAGE.
Cotton Conference in Jamaica ...	1
Notes on Grape Vine Culture ...	6
Nitrogen in Agriculture ...	7
Agricultural Education Conference at Gloucester	10
Heating or Fermentation of Hay	12
Culture of the Central American Rubber Tree, VI.	13
Board of Agriculture ...	20

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JANUARY. 1905.

Part 1.

COTTON CONFERENCE IN JAMAICA.

The Conference arranged by the Board of Agriculture to meet Messrs. E. L. Oliver and R. Stancliffe, the deputation from the British Cotton Growing Association, took place at the Institute of Jamaica on 29th November, 1904.

Among those present were His Excellency Sir J. Alexander Swettenham, the Hon. H. C. Bourne, His Grace the Archbishop, Hon. Lieut.-Col. Pinnock, Mr. H. H. Cousins, Hon. Dr. J. Pringle, C.M.G., Hon. W. Fawcett, Hon. T. H. Sharp, Mr. James Allwood, C.M.G., Mr. L. F. McKinnon, Mr. Upton, Mr. C. A. T. Fursdon, Mr. Warmington, Hon. H. Cork, Captain Egerton Eves, Hon. H. T. Ronaldson, Mr. A. W. Farquharson, Mr. R. A. Walcott, Mr. Broderick, Mr. J. Barclay, Mr. W. H. Johnson, and several other gentlemen interested in the cotton industry.

The Hon. H. Clarence Bourne, Chairman of the Board of Agriculture, occupied the chair.

Mr. Oliver said that was the first meeting which he had had in the West Indies without the presence of Sir Daniel Morris. He wished to convey to them Sir Daniel Morris' regret that owing to his long stay in England, his work in the West Indies had fallen into such arrears that it was impossible for him to accompany the members of the deputation to Jamaica.

The cotton industry of the West Indies had passed the experimental stage. It was undoubtedly a commercial success; more so, perhaps, in the other West Indian Islands than in Jamaica, where it was, comparatively speaking, in its infancy. Perhaps they in Jamaica could scarcely be said to be out of the experimental stage, but the progress which had been made in the other islands was simply phenomenal, and very great credit was due to Sir Daniel Morris and his staff on the one hand, and to Mr. Charles Wolstenholme, of the British Cotton Growing Association, on the other hand. The people of Jamaica had made more progress in this industry in two years than they might naturally have been expected to do in a life time. They had had the benefit of very sound advice and every word of that advice had been founded on the best possible experience of the United States.

Cotton was no stranger to these parts of the world, although it was a stranger perhaps to the present generation. During the American war there was a movement started here to resuscitate cotton growing, but it was given up. He did not think that that movement was so well organised as the present movement, and the circumstances were entirely different. At that time they had to deal with a state of affairs which was unusual and temporary. The present time was altogether different in this respect that the demand had been gradually overtaking the supply for some time and, therefore, there was much more hope of the present movement not proving merely a temporary one as the movement of 1862, 1863, and 1864.

He believed that the firm which he represented in England was the first firm to use Sea Island cotton grown in the West Indies—at any rate during the present movement. That cotton possessed very good qualities and very bad ones, and he intended to be perfectly frank with them and to tell them how they found it from the consumer's point of view. Sir Daniel Morris met him in Manchester on the 4th of July and he and Sir Gerald Strickland asked him (Mr. Oliver) to come out to the West Indies and speak to the planters, telling them how the English people found their cotton, and what they wanted and what they did not want. After a great deal of consideration he consented to come to the West Indies, and he was exceedingly glad that he had come. If he was only able to teach as much as he had learnt, then he thought he would have done a little good by coming out.

The chief difficulty they had with the West Indian cotton was its mixed character—long and short, coarse and fine, strong and weak cotton, all in the same bag and, if it had not been for the interest taken in the West Indian cotton by Mr. Charles Wolstenholme in assorting them, it was doubtful whether they would have been used at all. Mixed cotton was very unpopular, and if it had not been that the last year was a time of phenomenal scarcity of cotton it was probable that this kind of cotton would not have been tried—at any rate by the general market.

He had been greatly interested in cotton experiments, and he had used Sea Island cotton grown in Fiji, Tahiti, Solomon Islands and other places, and he had also used Sea Island cotton, grown in Egypt; and he and others had found that there was a considerably larger amount of waste in the West Indian cotton than in cotton grown in the American Sea Islands and the other places mentioned. The percentage of waste in the West Indian cotton was 11 per cent. greater in some instances. Instead of getting 60 lbs. of cotton yarn out of 100 lbs. of cotton they got less than 50 per cent. This was caused almost entirely by the presence of unripe fibre, and they should be careful not to pick the cotton until it was properly ripe.

In Barbados, St. Vincent, St. Kitts, and Nevis, they had been examining cotton which had been ratooned and they had come to

the definite conclusion that if they wanted to make a success of cotton growing they must not allow it to ratoon. They must not attempt to grow together two crops from the same seed. They must plant fresh seeds every year.

Another point he wanted to call to their attention was that in other islands they would not grow cotton in the same ground two crops in succession. They grew cotton on certain lands in one year and something else in the next year. He thought that was a wise decision.

He had been asked whether Egyptian cotton was the best to grow here. For Egyptian cotton there was an absolutely unlimited demand but whether it would pay them to grow it he did not know. What they would receive for Egyptian cotton would not be more than one half, if as much, as what they would receive for good cotton grown from such seeds as the Imperial Department of Agriculture secured from Mr. E. L. River's estate of last year. He should be sorry to discourage experiments made with Egyptian cotton. They were discouraging them in the smaller islands because of the risk of mixing the seed, but Jamaica was big enough to try the experiments with regard to Egyptian cotton. An important point which he desired to bring home to them was that if they were growing Egyptian cotton then it should be confined to a certain area.

They must most carefully avoid mixing the seed of long staple and short staple cotton, and if through any cause whatever after selecting the cotton seed, that grown on one patch should be inferior to that grown on another patch, then keep them separate; for, if you mix them you will only obtain a price equal to the worst cotton in each bag; and even then you will find it difficult to find a market for it, as a spinner will avoid buying mixed cotton if there is a plentiful supply on the market. Just as the strength of a chain is its weakest link, so is cotton only worth the value of the poorest cotton in the bag. If necessary the crops should be divided into three grades, and if that is done full market prices will be realized for each grade.

He had been asked to say if it was necessary to obtain fresh seed for the next season. Sir Daniel Morris and the Department were now engaged in making experiments to find out if it was necessary to import seed every year from the States. Personally, he did not think so. They, however, would have to await the result of the experiments.

He had also been asked whether it was not wiser to cross the native with the Sea Island variety to avoid insects and other pests. All he would tell them was if they gave up the idea of ratooning then they need fear no ravages from pests.

It was very essential to pick the cotton as clean as could possibly be done, and only to pick when the cotton was ripe. Pickers who picked clean ought to receive a higher scale of pay than those who brought in the cotton with chips and scale. The result of the

chips and scale being left in was to spoil the cotton when it went into the gin.

With regard to baling it would be well if the cotton was baled so that it would arrive in the best possible condition. Some of the cotton from the West Indies was sent out in bales bound round with iron bands like Florida and Georgia Sea Island cotton, but he understood in some cases presses had been obtained for making up the cotton in bags without bands which will give the bales the same appearance as the cotton from Edisto and James Island. He did not think that a single planter in Edisto or James Island puts bands round his cotton, and to see bales with iron bands round them might lead some spinners to be suspicious lest they were buying Florida and Georgia Sea Island and not real Sea Island grown upon the islands.

Mr. Oliver then passed round samples of waste as it came from the cotton spinning factory in England, taken from Barbados, also samples of ladies gloves manufactured from cotton that contained cotton grown in the West Indies.

SOME QUESTIONS.

The Chairman said that if any one desired to ask any questions Mr. Oliver would be pleased to answer them.

Mr. Ronaldson said he would like to understand whether ratoon cotton was of no use and whether they were not to grow ratoons?

Mr. Oliver replied that his advice was not to have anything to do with ratoons. The cotton yielded from them was weak and poor and would not find a market. As soon as the first crop was reaped the trees should be destroyed and fresh seed planted.

Mr. Ronaldson said if that was the case he did not see how it could pay. He had recently put in 25 acres and it had cost £4 10s. an acre. He did not think it could pay if they were not to use the ratoons.

Mr. Walcott said he would like to know if Mr. Ronaldson had taken into consideration the yield from the seed and other by-products.

Mr. Oliver said that he knew two men in Barbados who made £10 an acre from their yield. He, however, repeated his advice against ratoons and pointed out that to establish a reputation, a regular standard quality will have to be maintained which can not be got from the cotton produced from ratoons.

Mr. Sharp said that with regard to the matter of ratooning he would like to say what was called a ratoon here was really not a ratoon. He knew of cases where two crops were grown in ten months. Except they were able to ratoon it would be a serious matter as far as Jamaica is concerned. Here the soil was different to most other places, as Mr. Cousins could tell them. He knew that as soon as the crop was ready all that was necessary was to gather the fruit and cut off the branches that had borne and get the next crop. He would like to know whether the tree was to be treated as an annual or whether the tree was to be destroyed after the first crop.

Mr. Oliver said of course the ratoon cotton could be grown and shipped but it would fetch a very much lower price, and in some cases remain unsold.

Mr. Oliver was asked what was the cost of picking, ginning and baling?

Picking, he said, was done in Barbados at $\frac{1}{2}$ cent per lb., and ginning and baling, three half-pence a lb.

Mr. Oliver was also asked whether it was better to have a big ginning district or that each man should have a gin of his own?

A large place, he replied, was worked more economically than a small one. He did not think it would pay a man to have a gin of his own unless he had 500 acres under cultivation. In his opinion a Central Factory would pay best such as at Barbados.

The Chairman said he thought they had all the information they wanted from Mr. Oliver and there was nothing left but to thank him for his advice. He also thought they ought to place on record a vote of thanks to the British Cotton Growing Association for taking the interest they did in this matter. He desired in thanking Mr. Oliver to thank Mr. Stancliffe too. He took it that the Meeting agreed to pass both votes of thanks.

This was unanimously agreed to.

Mr. Stancliffe, in reply, said he was very pleased to be there that morning, and he desired to thank them all for the kindness shown to both Mr. Oliver and himself. Everywhere they had been to, they had received proverbial West Indian hospitality for which he desired to return his sincere thanks. He wished them all prosperity in cotton growing and assured them that if they treated it with the same kindness that they had treated them then it must be a success. He hoped their visit would result in a new era for cotton growing in the West Indies.

COTTON FROM RATOON PLANTS.

Mr. Oliver, the cotton expert, stated that cotton from ratoon plants grown in various places all over the world, showed great deterioration, the plants very soon reverting to the condition of wild cotton.

After seeing the plants growing in Jamaica, he allowed that what was called here first ratoons did not correspond exactly to proper ratoons, but appeared to be rather a continuation of the original growth.

In Barbados he stated the planters went on picking their crop during 3 months, but here the crop matured on the first branches at much the same time, and then a second series of branches grow from below the original set: these second branches were known here as first ratoons.

Judging from the small sample that he had seen, he was inclined to think that there was no deterioration in the lint for the so-called first ratoons, but this was a question which could not be decisively answered until he had seen a much larger quantity.

NOTES ON GRAPE VINE CULTURE.

By W. J. THOMPSON, F.R.H.S. Travelling Instructor and Superintendent Parade Garden.

On account of the unusual rains grape vines have made more growth than is good for them. To counteract the late excessive growth, people who possess only one vine, and wish it to give a good crop of fruit this year, should see that it is kept as dry as possible till about the middle of January, and also that it gets as much sunlight and air as can be given it. The reason for this is, that the past season's main growth of the vine may become quite ripe; for it is the good ripe wood of the grape vine that determines the amount of fruit, and not the pruning. If the wood is thick, enough and ripe, fruit will come in the spring, even if the pruning is not of the best description.

The above applies to vines that were not pruned late last year. Vines that have been ill-used by being pruned twice in the year should not be pruned again till late in the spring.

Grape vines should only get one general pruning each year, more than this is injurious to them.

People who have several vines with quite ripe wood, should have begun to prune in December and should prune one or two vines every fortnight so as to get a succession of fruit. With enough vines and proper treatment, grapes can be had most of the year through.

From the time water is withheld from the vines, so as to ripen the wood, it should not be again given to the roots until about a week after the plants have been pruned, then the vines should be given an abundant supply of water so as to start them into growth. When the young growths are a few inches long, the vines should receive a supply of water at the roots like the other plants in the garden. It must be distinctly understood that while old vines will stand any amount of water at their roots, great care has to be taken in watering newly planted young vines, as they will die from being over-watered. When the fruit is beginning to ripen, water should be withheld from the roots. After the fruit is gathered, and if a second small crop should be coming on the lateral growths, the usual supply of water can be given. But care must be taken to see that the vines are not kept growing and fruiting for too many months in the year.

If a vine is restricted so as to have only one crop of fruit each year, it would be better for it and better for the owner.

When the vine has been pruned and started into growth care should be taken to see that as soon as the young growths are about four to six inches long that too many are not allowed to remain on the vine. This can be remedied by rubbing off the smallest growths with the thumb and fingers, and only allowing one good growth to grow from one section of the vine instead of three or four weak ones.

In pruning care should be taken that too many main growths are not left, so as not to get the vine overcrowded; and when the cut is made, see that it is close to one of the main stems.

I find that in some gardens when the plants have had plenty of soil and manure about the roots, that the vines have begun to fruit on the lateral branches. In such cases, it will be the wisest plan to dry the vines off for about a month by exposing the base of the plants and withholding water, then they should be pruned. If this fruit is allowed to remain on and ripen the vines will not be able to form good new wood for another year.

NITROGEN IN AGRICULTURE.

Extract from an Address by DR. SOMERVILLE, at the British Association.

The Chemical Fixation of Atmospheric Nitrogen.

It has for long been the dream of chemists to discover, or welcome the discovery of, a chemical process, capable of industrial application, by which the nitrogen of the air could be made available to replace or to supplement our rather limited supplies of nitrogenous manures. In his Presidential Address, Sir William Crookes had something to say on this fascinating subject, and looked hopefully to electricity to solve the problem. He pointed out that with current costing one-third of a penny per Board of Trade unit a ton of nitrate of soda could be produced for £26; while at a cost of one-seventeenth of a penny per unit, a rate possible when large natural sources of power, like Niagara, are available, the cost of such artificial nitrate of soda need not be more than £5 per ton.*

Dr. von Lepel, in giving an account of recent work on this subject to the winter meeting of the German Agricultural Society in February of this year,† puts the cost of electric nitrate, as compared with Chili nitrate, in the proportion of 24 to 39, which is in close agreement with Sir William Crookes's estimate. Lepel points out that the material obtained, neutralised by some alkali, consists of a mixture of nitrate and nitrite. When used in pot-culture experiments it has given results closely agreeing with those furnished by Chili nitrate.

Good progress would also appear to have been made in another direction in the commercial fixation of atmospheric nitrogen, and a short account of the results was communicated by Prof. Gerlach, of Posen, to the meeting of the German Agricultural Society already referred to, and is published in the same issue of the *Mittheilungen*.

When air which has been freed of oxygen is conducted through finely disintegrated calcium carbide at a high temperature, one

* Crookes, "The Wheat Problem." p. 47.

† Dr. von Lepel, *Neuere Versuche zur Nutzharmachung des atmosphärischen Stickstoffs durch Elektrische Flammenbogen*, "Mittel de Deut. Land. Gesell., 1904, Stück 8"

atom of carbon is displaced by two atoms of nitrogen, and calcium cyanamide (CaCN_2) is formed. This substance is also produced when a mixture of lime or chalk and charcoal is heated to a temperature of $2,000^\circ \text{C}$. in a current of air.* When pure, this substance holds 35 per cent. of nitrogen, but in its crude commercial form it contains only about 20 per cent. Treated with acids, calcium cyanamide is changed into dicyandiamide, a substance holding nearly 67 per cent. of nitrogen, but directly poisonous to plants. Or, if heated in superheated steam, calcium cyanamide parts with all its nitrogen as ammonia, which, of course, is easily brought into a portable form.

But experiments conducted at Posen and Darmstadt during the past three years, both in pots and in the open field, have shown that calcium cyanamide itself is a useful nitrogenous manure, field experiments giving results about 20 per cent. below those obtained by the use of an equal amount of nitrogen in the form of sulphate of ammonia. In prepared soil in pots the results fully surpassed those obtained both with nitrate of soda and sulphate of ammonia, the less satisfactory yields obtained in the field being perhaps due to the organic acids inducing the formation of a certain amount of the poisonous dicyandiamide.

So far as one may judge from the information available, it would appear that agriculture will not have long to wait until it is placed in the possession of new supplies of that most powerful agent of production, nitrogen, and Sir William Crookes will see the fulfilment of his prediction that "the future can take care of itself."

Nitragin.

A few years ago much interest was excited in this and other countries by the announcement that the scientific discoveries of Hellriegel and Wilfarth had received commercial application, and that the organisms of the nodules of the roots of Leguminosæ could be purchased in a form convenient for artificial inoculation. The specific cultures placed upon the market were largely tested practically and experimentally, but the results were such as to convince even the patentees, Nobbe and Hiltner, that the problem which promised so much for agriculture had not been satisfactorily solved. Since that time however, investigators have not been idle, and the present position of the subject is to be found in a recent report by Hiltner and Störmer.†

It was early recognised that the organisms (bacteria) which inhabited the root-nodules of the various species of Leguminosæ were not all alike, and that, in fact, they showed marked physiological if not morphological distinctions. Any particular species of leguminous plant is found to resist more or less successfully the attempt of these various organisms to effect an entrance into its

* Bull. Imp. Inst. June 30th, 1904.

† "Bericht über neue Untersuchungen über die Wurzelknöllchen der Leguminosen und deren Erreger," *Arbeiten aus der Biol. Abteil. für Land- und Forstwirtschaft am K. Gesundheitsamte*, Band iii. Heft 3.

root-hairs, and according to the power of the organism to gain access, and to establish colonies, so is the particular plant benefitted and the stock of fixed nitrogen increased. This power of the adaptability of the organism is designated its "virulence," a term, however, which is perhaps hardly suited to our English mode of expression, though it may for the present be retained. It has been found that organisms of what is called "high-virulence" are capable of entering with ease the root-hairs of vigorous plants at an early stage of their growth, and of inducing the formation of nodules that are large, numerous and placed high up on the roots. Organisms of low virulence, on the other hand, can only enter plants of feeble growth, or plants that have passed the most vigorous stage of youth, so that the nodules, in this case, are small and scarce, and distributed, for the most part, near the ends of the roots. The practical object, therefore, would appear to be the breeding of strains or varieties of organisms of high virulence, adapted to the symbiotic requirements of the various important species of farm and garden leguminous crops.

The nitragin put on the market a few years ago was used in two ways, being either applied directly to the fields, or mixed with water and brought into contact with the seed before sowing. Under the former method of procedure an increase of crop was obtained only when the nitragin was used on land containing much humus. The explanation given for failure under other conditions was that the bacteria artificially introduced perished for want of food before the leguminous seed germinated and produced plants.

Failure of the nitragin to effect an improvement in the crop when it was sprinkled on the seed is now believed to be due to the action of secretions produced by the seed in the early stages of germination. These secretions are found to be rich in salts of potash, and when brought into contact with the bacteria in question they induce changes allied to plasmolysis, and these changes are subsequently followed by death. This difficulty was found to be got over by moistening the seed and allowing it to sprout before the nitragin was applied; but manifestly such a procedure would always be difficult, and often impossible, to carry out in practice. The object, however, would appear to have been gained in another way, namely, by cultivating the bacteria in a medium that imparts to them the necessary power of resistance. Such nourishment may take various forms, but that which gave the best results consisted of a mixture of skim milk, grape sugar and pepton, and it is in this medium that the organisms of the nitrogen now distributed are cultivated.

Early in the present year the new nitragin was being offered free of cost to all members of the German Agricultural Society on the condition that it was used in accordance with the directions that accompany it. In consequence of the large demand the free offer was in April withdrawn, but the substance may be purchased from Prof. Hiltner, of Munich, in quantities sufficient to treat the

seed of a half to one acre at the price of one shilling. The United States Department of Agriculture are so convinced of the practical utility of the improved nitratin that they are distributing large quantities to American farmers. In this way the material will be thoroughly tried in two hemispheres under practical conditions, and abundant evidence should soon be forthcoming as regards its effects. It is to be hoped that British investigators will not be deterred by past disappointments from putting the new form of nitratin to the test.

THE AGRICULTURAL EDUCATION CONFERENCE AT GLOUCESTER.*

Under the auspices of the Gloucestershire County Council, a conference on agricultural education was held at the Shire Hall, Gloucester, on October 15. There was a large attendance not only of those locally interested in either education or agriculture, but also of delegates from many of the other counties. After a few preliminary remarks from the Chairman, Sir John Dorrington, Lord Onslow opened the proceedings, and explained the work his department was charged with in regard to education. He justified the retention of that work by the Board of Agriculture instead of allowing it to be merged in the general educational system administered by the Board of Education, on the plea that agriculture in England was so far from being the leading industry that the specialised education it required would get scant attention were there not his own department peculiarly interested in fostering it. He claimed that the constant and sympathetic communication between the two departments secured more favourable results than could be acquired under the Board of Education exclusively. The work of the Board of Agriculture was confined to assisting the collegiate centres under which the greater part of the country was now grouped; there was, however, a large blank on the educational map, for the whole of the west country, including Gloucestershire itself, had no centre of university rank from which agricultural instruction emanated. He trusted that the present conference would pave the way towards remedying the need he had indicated.

Sir William Hart-Dyke, to whom the first paper, on higher agricultural education, had been entrusted, was unable to be present; his paper, of which an abstract was read, warned the meeting of the difficulty that now confronted all countries in the matter of higher education because of the great draft on their funds for the future training of elementary schoolmasters.

A paper by Prof. Middleton, of Cambridge University, next dealt with the proper function of experimental plots in local agricultural education; Prof. Percival, of Reading, who followed, dealt with the ideal course of instruction in an agricultural college. The

*From "*Nature*," October 20, 1904.

current courses, he maintained, were far too scientific ; chemistry, botany and kindred sciences should be reduced to a minimum in favour of work on the farm, a thoroughly popular programme which appealed to the "practical men" in the room.

Lord Monteagle then opened the second part of the proceedings, on the education of the small farmer, with an account of the way the Irish Board of Agriculture had gone to work.

In Ireland the central authority administered the larger part of the fund, contributing five-ninths of the cost of any work, and securing four ninths from the local authority ; thus the organisation proceeded more evenly over the whole country than in England, where the initiative rests with the local authority. Next, they had proceeded in Ireland on the principle of establishing no institution until they had created a demand for it by means of pioneer lecturing and demonstrations. Lastly, in Ireland they believed that the industrial organisation of the farmers must go hand in hand with their education.

Prof. Wallace, of Edinburgh, who followed dwelt on the necessity of beginning an agricultural training at an early age, so far as practical work on the farm went, leaving the true technical instruction to come when the lad had matured. Mr. Frederick Verney also dwelt on the harm that was being done to country children by keeping them at unsuitable school subjects until they had lost all taste for farming pursuits ; the present system of elementary education contributed both to the depopulation of the country and the overcrowding of the towns.

Mr. H. Hobhouse, M.P., spoke on the value of attaching agricultural sides to the ordinary country grammar schools the training would not be technical, but scientific with an agricultural bias.

After lunch Mr. Morant expressed his pleasure at the opportunity the conference afforded him of learning the feelings of the great agricultural community towards the educational system of the country. He assured the meeting that the Board of Education was wholly anxious to assist, provided the men who represented agriculture on such occasions would make their views precise, and, instead of grumbling at large, would indicate exactly what worked harshly or harmfully in the present arrangements controlled by the Board of Education.

A paper by Sir C. Dyke Acland was then read in his absence ; it dealt with the education of the labourer, and was, like so many that followed, a plea for more intelligent teaching in our elementary schools, and for a more flexible system which would partially liberate boys at an earlier age for light work on the farm. Mr. G. Lambert, M.P., and Mr. Martin F. Sutton emphasized this point of view, and, like Mr. Acland, they agreed that in the main rural labour difficulties had been caused by keeping the rate of wages too low, with consequent loss of efficiency.

The last section of the conference, on the education of the teacher and expert, was opened by Mr. A. D. Hall, who pleaded

for a more rigorous training which should include some experience in farming for the teacher of agriculture, and some work at research for the man who dealt with agricultural science. Canon Steward, principal of the Salisbury Training College, discussed more generally the education of the elementary schoolmaster and mistress in country districts, and finally Mr. R. P. Ward gave an account of the way the teachers were being trained in Cheshire.

In the discussion which followed most of the speakers urged the substitution of winter schools or of evening continuation schools for the compulsory attendance of country boys at school up to the age of fourteen; for farm purposes a boy ought to begin light work on the farm at the age of twelve at latest, though his education should go on much later than it does now.

The conference was noteworthy not only for the quality of the papers read, but for the advance they showed in the direction of organisation on those submitted to previous conferences. It was made clear that there are several different classes to be provided for; the large farmer's son or future land agent wants a different equipment from that of the small holder; the farmer himself must be reached by an entirely different method; the labourer, again, has to be treated separately. At Gloucester the various speakers defined clearly their aim and their method; in former gatherings of the same nature the speakers seemed to consider there was only one kind of worker engaged in agriculture.

THE HEATING OR FERMENTATION OF HAY.*

It is well known that when hay which is not quite dry is placed in a shed or stack, spontaneous generation of heat takes place. It has generally been held that this action is entirely due to the work and activity of bacteria, but recent investigations by Boekhout and Vries at the Agricultural Experiment Station of Hoorn, in Holland, appear to prove that the fermentation of hay is a purely chemical process, and is quite independent of the work of living organisms. They ascertained the temperature of haystacks in which heating was manifestly taking place, and found that it might considerably exceed 200 degrees F. As compared with ordinary hay which had not undergone much fermentation, heated hay was found to contain a larger percentage of albumenoids, woody fibre, and fat, but a smaller quantity of sugar and starch. Furthermore, the heated hay was markedly sour, owing to the presence of considerable quantities of formic acid.

The investigators then proceeded to construct an apparatus which enabled them, through the agency of steam and air, to reproduce very closely in the laboratory the changes that take place in the haystack. The hay was kept under treatment for twenty days, at the end of which time the material smelt exactly like hay

* From *Centralblatt für Bakteriologie, Parasitenkunde u. Infektionskrankheiten*. September, 1904. *Journal of Board of Agriculture*, London.

that had fermented in a stack, and when subjected to chemical analysis it showed precisely the same changes as were found to have taken place in hay which had heated naturally. The temperature of the receptacle in which the artificially heated hay was kept was never less than 203 degrees F., so that the conditions were such as to preclude the activity of living organisms. In order, however, to verify the result, hay was sterilised at a temperature of 248 degrees F., and this material also, when put through laboratory treatment, attained the same condition and composition as heated hay from a stack.

The investigators are therefore perfectly confident that they have proved satisfactorily that the fermentation of a hay stack is in no way associated with the activity of living organisms, though they do not yet feel justified in attempting to offer an explanation of the causes that induce the high temperatures which are met with in the interior of a mass of fermenting hay. As they consider that they have shown that this form of so-called fermentation is purely chemical, they are disposed to cast doubts on the necessity of any bacterial action in the case of many other similar processes, as, for example, in the maturing or fermentation of tobacco.*

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, VI.†

(Continued from *Bulletin* for December, 1904.)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

THE CULTURE OF CASTILLOA.

In attempting to plan a rational culture for *Castilloa* it will be worse than useless to insist upon all or any of the cultural measures which have been found desirable with coffee, cacao, or other tropical crops. *Castilloa* is not cultivated for the leaves like coca, for the flowers like cloves, for the fruits like oranges, nor for the seeds like coffee. The increase of the size of the trunk and of the amount of milk contained in its inner bark are objects of cultural solicitude.

SHADE IN THE CULTURE OF CASTILLOA.

SHADE NOT A NECESSITY.

Much of the preceding discussions of the habits of *Castilloa* and of the climatic conditions suitable to its culture may also serve as preliminary to the consideration of the question whether planta-

* Dr. Loew, under the direction of Prof. B. T. Galloway, chief of the Division of Vegetable Physiology & Pathology, U. States Department of Agriculture, has investigated the curing and fermentation of cigar leaf tobacco. The result of his work is to show that the principal changes that take place are due to the action of soluble ferments or enzymes, not bacteria; and that the development of colour and aroma is due principally to the action of oxidising enzymes. (*Misc. Publications*, No. 52, 1899.) [Editor.]

† Extract from U. S. Department of Agriculture. Bull. No. 49, Bureau of Plant Industry.

tations of *Castilloa* require the shade of larger trees or may be exposed to full sunlight. The argument that *Castilloa* always grows in shady locations in nature is by no means conclusive, since it is well known that many forest trees thrive better when they have the opportunity of standing alone and are free from the close competition for food and sunlight implied by forest conditions. It is also certain that *Castilloa* is not only able to obtain an existence in the open, but that it makes much more rapid growth quite without shade than it does in the forest. If the problem were merely to secure the quick growth of *Castilloa* there would be no hesitation between these two methods of planting; but there are many stages between dense forest and clean culture, and the question may well be raised whether the conditions most favourable for rubber production are not to be found in some of these. Advocates of both extremes and all intermediate conditions are not lacking, so that the question of shade with *Castilloa* bids fair to become as complicated and as extensively debated as with coffee and cacao. Moreover, as with those crops, it may be found to have no general solution, but to depend upon local conditions of soil and climate.

That rubber can be grown under forest conditions there can be no doubt, since all the natural supplies are to be credited to this method of production, but the desirability of forest planting does not necessarily follow, since it is equally certain that under the deep shade the trees grow with an extreme slowness, which would exhaust the patience of any investor. Moreover, as previously shown, it may well be doubted whether a plantation of *Castilloa* would ever grow to normal maturity in the undisturbed forest; the indications are that only those trees survive which are able to profit by accidents to their larger neighbours and thus receive more sunlight than usually reaches the undergrowth of a dense tropical forest. In other words, regular forest planting does not mean the placing of *Castilloa* under conditions most favorable to its growth in nature; these are more nearly attained when the forest is thinned out or partly cut away.

Koschny, who distinguishes four kinds of *Castilloa* in Costa Rica, says that the "hule blanco," or white *Castilloa*, is the only one adapted for cultivation, and that this is never found in the deep forest, but in more open places, where the foliage has access to the sunlight.

Experiments with forest planting were studied in eastern Guatemala and in Southern Mexico, and in both instances the young trees were at an obvious disadvantage in comparison with others planted at the same time in more open situations. Many individuals had hardly grown at all in six months and many had died. On the other hand, it should be explained that the trees, while they had no shade overhead were not exposed to the extent which might be implied by the term "open culture," since they stood in a clearing only a few acres in extent. The neighbouring forest

gave shade in the morning and afternoon, and the atmosphere was undoubtedly kept far more humid throughout the day than would be the case in a large tract of unshaded land baked by the tropical sun. They were also undoubtedly assisted by a mulch of dead leaves and brush. Trees 12 feet high were said to be only 1 year old.

It would seem, then, that one of the extreme suggestions—the planting of rubber in the undisturbed forest—is clearly inadvisable and may be dismissed from further consideration. The other extreme—clean culture—is not so readily condemned as impracticable, since observations in southern Mexico establish the fact that even single trees, standing in the open sun and with little other vegetation near them, are not only able to survive six months of dry weather, but actually remain more leafy at the end of the dry season and thus appear to suffer less from drought than those on land covered with weeds and bushes. The reason for this apparent anomaly may not be difficult to conjecture, since it is plain that a tree standing in cleared ground has a monopoly of all the moisture which rises in the soil, and may thus have a distinct advantage over one obliged to share a similar supply of water with a tangled mass of other plants which expose to the atmosphere a total leaf surface many times that of the young rubber tree. Moreover, it is also clear that the water required to supply the needs of this large amount of vegetation would greatly exceed that which escaped from the exposed surface of the soil. It is even doubtful whether a covering of low vegetation greatly checks the evaporation from the soil; it may be as great or greater than where the surface of exposed soil is loosened by stirring and thus forms a layer which hinders the access of dry air and is a nonconductor of heat. In previous discussions of shade in the culture of *Castilloa* this distinction between open culture and clean culture seems to have been overlooked, and the question of shade has continued to be confused with that of water supply. The statements of various writers that the leaves are unable to withstand exposure to the full sun because of their delicate texture are quite erroneous. The tree needs sunlight, and it is benefited by it as long as the water supply is sufficient, but when this becomes deficient the leaves shrivel. The light is no brighter and the temperature no higher in the dry season, which in Mexico occurs in the winter months; but the dry atmosphere demands more water, while the soil supplies less.

The rapidity with which dry atmosphere takes water from a plant may be judged by the promptness with which the leaves of a broken branch wilt and shrivel, and this happens very promptly with *Castilloa*. Many plants have developed no expedients for resisting evaporation and are accordingly confined to continuously humid regions, but *Castilloa*, as has already been seen, is adapted in several ways for resisting drought. The leaves themselves are, it is true, of rather loose texture and have only the slight assistance

of the hairs of the lower surface as a protection against excessive transpiration. The leaves suffer when they are obliged to part with more water than they can obtain, and their falling off is then an advantage because it decreases the demand for water. Thus, although *Castilleja* is not a desert plant, the falling of its leaves in the dry season is the same physiological phenomenon which appears so conspicuously in deserts, viz., the loss of the leaves as a protection against drought. Many desert plants such as *Parkinsonia*, *Fouquieria*, *Peireskia*, and species of *Euphorbia* put out leaves for the wet season only, while most of the *Cactaceæ* and many *Euphorbias* have discarded leaves entirely and expose as little surface as possible to the air.

This digression may help to make it apparent that the planter who desires to give intelligent consideration to the agricultural question of shade should dismiss the notion that the rubber tree derives a direct advantage from standing in the shadow of another tree, on the contrary, it is probable that interference with the sunlight is always a direct disadvantage. Shade, if used at all, is to be applied and justified on the ground that it will preserve the moisture of the soil or of the atmosphere or serve some other cultural purpose. By conserving the soil moisture, clean culture may produce some of the desirable effects commonly ascribed to shade. Open culture may be, and probably is, less advisable than either clean culture or a moderate shade culture.

Open culture with relatively little cleaning at first would be more practicable if the weeds and undergrowth cut down in the dry season could be left spread over the ground. This would do more to conserve the moisture of the soil than the same vegetation alive, but the danger of fire will in moist localities forbid the use of this method of culture.

If the present question could be settled by deciding whether or not *Castilleja* needs to be protected from the sun, it would be easy to establish the negative view; but with shade recognized as a means of influencing natural conditions of soil or climate it becomes evident that each planter will need to use his best judgment in determining what local conditions require. In Costa Rica, Koschny advises the thinning of the forest by the removal of two or three trees out of every five. At La Zacualpa more are cut out. Some of the planters on the Isthmus of Tehuantepec practice clean culture. No general principles will determine which is best, because no one method is applicable everywhere.

RELATIVE COST OF SHADE CULTURE.

It must be remembered, in addition, that the planter finds himself compelled to decide not what will be the best for the rubber trees, but what is the best he can afford to do for them. Is it, for example, good policy to use labour and capital in keeping a tract of planted land clean, or will more be gained ultimately if one contents himself with somewhat slower growth and improves the opportunity of planting additional tracts with trees that can

also be growing? Careful comparative experiments might be necessary for an answer, and this might differ for different localities.

EFFECT OF SHADE ON FORM OF TREE

There are great and persistent differences of shape or "habit" among trees. The Lombardy poplar and the weeping willow are not distant relatives. It is a general fact, however, that forest trees are taller and more slender than those of the same species grown in the open. The low spreading habit, which is desired and encouraged among fruit trees, is not desirable in rubber-producing species, where a large expanse of trunk is needed to supply the milk and to give opportunity for tapping without the necessity of wounding the same place too often. *Castilloa* trees growing alone in the open often send out permanent branches 8 or 10 feet from the ground, while those in the forest may have from 20 to 40 feet of smooth trunk before the permanent branches are reached. Open-grown trees may have large spreading branches, while in the forest or under close planting the main axis of the tree continues to grow upward and the lateral branches are relatively small.

The problems of rubber culture may prove in this respect to be directly opposite to those of coffee, where the formation of much wood in proportion to leafage is a sign of unfavourable conditions or of bad plantation management. It does not follow, however, as some have seemed to suppose, that forest shade is necessary to grow long-trunked trees. In coffee culture it is plain that the most wood is formed not by shade culture, but by planting close in the open, and the older-planted trees of *Castilloa* at La Zacualpa, if not as slender and as smooth-trunked as those of the forest, are certainly tall and slender enough to furnish ample evidence that open culture does not cause a low, spreading growth, if the trees stand close enough together. The Zacualpa experiment is of further significance in this connection, because it shows that a harmful degree of crowding was by no means reached. In numerous instances where from three to five trees grew in a cluster their trunks were each equal in size to those of many of their neighbours which stood alone.*

Coffee trees which stand too close together lose the use of their lower branches, which become interlaced and shade one another, and ultimately only the top of each tree continues to grow and produce fruit. The planter must choose a middle course between the injury of his bearing trees by crowding and the waste of capital and labour in keeping clean unused land between trees planted too far apart. With the rubber tree the seed is a consideration entirely secondary to the growth of the trunk. In comparison with coffee it may be said that the crowding of rubber trees is desirable, and that it finds its limit, not in the discourage-

* Planting in clusters might be advisable on some accounts, since the trees would better shade their trunks and the ground under them, but the difficulty of properly tapping such trees would seem to exclude this method of culture.

ment of lateral branches, nor even in the lessening of the size of the individual trees, but in the decrease in the amount of rubber which can be produced on a given area of land.

SHADE AND RUBBER PRODUCTION.

The general question of shade can not, however, be treated as closed until its influence on the yield of rubber has been tested by careful experiment. From the facts given on previous pages it appears very improbable that less rubber will be formed in the open than under shade; the difficulty, if any, is likely to arise in connection with the extraction of the rubber. The desirability of tall trunks to afford a large tapping surface has been noted already, but there may be other disturbing factors. The pressure of the liquids inside a tall columnar trunk may be greater than if it were thicker and shorter, so that more milk would be forced out on tapping. The bark of trees more exposed to wind and sunlight becomes thicker and there may be differences in texture which would affect the flow of milk. The air is much dryer outside than inside the forest, and this might soon impede the flow of milk, though this suggestion seems to be negated by the fact that milk flows more freely from wild *Castilloa* on the dry Pacific slope of Mexico and Central America than in the more humid districts of the Atlantic side.

A recent writer on the shade question claims to have discovered that, while planting under partial shade hinders the growth of the trees, it greatly increases the yield of rubber. The managing director of a rubber plantation operating in Mexico writes as follows to the *India Rubber World*:

We are planting in the partial shade; a great many planters are planting in open sunlight. My honest opinion is that every one who has planted in open sunlight will get a tree 50 per cent larger in five or six years than we in the partial shade. On the other hand, we will get from 60 to 75 per cent. more rubber from a small tree than they do from a large one. About three months' careful study was made of this proposition; the trees were tapped both in the shade, partial shade, and open sunlight, and the results carefully tabulated by a committee of which I was not a member.

It is easy, however, to understand how such an opinion could be formed if the experiments in tapping were made at a time when the trees planted in the open were drier than those in the shade, and such a difference would be especially pronounced in young trees. This observer did not find that the milk was richer in rubber in the shade, but merely that at a certain time more milk flowed from the shaded tree than from the unshaded tree. This would not, however, be an argument for shade planting unless it were shown that the unshaded trees would not at any other time yield more milk. It is quite probable that shaded and unshaded trees might need to be tapped at different times to secure a maximum flow, or it might be found that unshaded trees could be tapped with impunity more frequently than the others, and thus afford a larger annual yield. The flow of milk does not depend so much upon the amount in the tree as upon the pressure existing

at the time the tree is tapped. The indications are that pressure attains its greatest intensity in trees which are exposed for a part of the time to a relatively dry atmosphere and which are accustomed, as it were, to pump water rapidly to supply the leaves. Such trees may, on the contrary, yield no milk at all when the water supply is deficient. It may be expected, therefore that open culture will require much more careful attention to the time of tapping. This may prove a disadvantage if it requires all the trees of a large plantation to be tapped on the same day or in the same week, but this is not likely. On the other hand, tapping at the right time would mean the drawing of a larger amount of milk from a smaller cut, a saving of labour, and a lessening of injury to the trees.

The above considerations make it easy to understand also that writers acquainted with humid districts commonly refer to the rubber harvest as occurring in the dry season, while in the drier regions, as in Soconusco, the beginning of the rainy season is the recognized time, when the tree's demand for water is largest and the internal pressure highest.

LEGUMINOUS SHADE TREES TO BE PREFERRED.

Where the policy of thinning out the forest is followed the question arises as to which trees are to be left and which cut down. A study of coffee and cacao culture has revealed the probability that much of the benefit ascribed to shade is due in reality to the nitrogen furnished by the bacteria of the root tubercles of the leguminous trees which are preferred in all countries where the shade culture of coffee has become popular. If shade trees are to be planted with rubber, they must be different from the species of Inga which are preferred for coffee shade in Mexico and Central America, for the reason that Castilleja grows faster than Inga. Some leguminous trees, however, grow with great rapidity and may be able to outstrip the rubber. No comparative experiments seem to have been made. If, as suggested above, shade trees are more useful as windbreaks than for the shadow they cast on the rubber, the planting of fruit trees like the mango or other useful species in rows or hedges would be preferable to scattering them amongst the rubber.

DISTANCE BETWEEN TREES.

As yet there have been no experiments yielding any definite information on the above point, but the recent trend of opinion among planters seems to be distinctly in the direction of closer planting. There has been a gradual decline from 20 feet and upward between trees to 12 feet and under.

The questions of shade and of distance between trees are closely related and need to be considered together because several of the arguments for shade can be met, wholly or partially, by close planting. The first of these is that of the greater expense incidental to open culture. The frequency with which the land requires to be cleaned and the period of years during which it would be necessary

to continue such cleaning depends largely upon the amount of overhead shade present to discourage the undergrowth. Some planters on the Isthmus of Tehuantepec are evidently taking advantage of this fact and are setting close, with the intention of removing alternate trees before they are large enough to injure their neighbours by crowding; and it is expected that if they are "tapped to death" they can be made to yield enough rubber to more than cover the expense of planting. At least there seems to be no reason why, if the land is to be cleared, it should not be made to produce as much rubber as possible instead of being planted with useless trees for a purpose which can be attained quite as fully by setting the rubber trees closer together.

There is danger, however, that any suggestion which promises earlier returns from rubber culture will be overdone. The rubber of very young trees is of low grade and expensive to collect; also it would be very poor policy to risk permanent injury from weak spindling growth, which overcrowding would undoubtedly cause. More is likely to be lost than gained by trees standing at less than 8 feet for even a few years. Better than uniform close planting would be to set the north and south rows farther apart than the trees in the rows. With a given number of trees this would secure the maximum of shade on the ground, because the morning and afternoon sun would not shine down the rows. The cleaning of the land or the cultivation of a catch crop or a shade crop between the rows would also be facilitated. The distances would depend on the size which the *Castilloa* trees were expected to attain in any given locality, the rows from 12 to 20 feet apart, the trees from 8 to 12 feet in the rows being fair average estimates.

(To be continued.)

BOARD OF AGRICULTURE.

A Special Meeting called to consider the matter of the Locked Still at Denbigh Estate was held on 1st November, 1904. Present: the Hon. Colonial Secretary, Chairman; the Director Public Gardens, the Chemist, His Grace the Archbishop, the Hons. T. Capper, J. V. Calder and H. Cork, and the Secretary, John Barclay.

Resignation of Mr. Sharp.—Mr. Cousins asked if he might put forward a special matter, as it was urgent. This was the resignation of Mr. T. H. Sharp, jr., Superintendent of Manurial Experiments, who asked permission to leave on November 15th. To fill the vacancy, the name was suggested of Mr. P. W. Murray, son of Dr. Clark Murray of Brown's Town, who had been through a five years' course at an Agricultural Institute in Virginia. The Chemist was directed to bring the name of Mr. Murray before the Government with a view to asking him to act temporarily as Superintendent of Manurial Experiments at a salary of £100 a year.

Sugar Grant.—The Chairman said that he had satisfied himself that the disposal of the sugar grant was in the hands of the Board and that he ruled that the mere fact of the Board sanctioning the

expenditure of £1,000 for new machinery was not sufficient to take out of their hands the power of allocating the details of the expenditure. It was in the power of the Board to determine that the money charged to the Sugar Grant for the Locked Still matter, on the responsibility of the former Chairman of the Board, should not be met from the Grant. In that case the Government could only ask the Legislative Council for a special vote for the purpose, and if the Council refused then Mr. Olivier would be personally responsible for the payment of the amount.

Locked Still.—The Secretary read a letter from Mr. Shore stating that he did not think the Meeting was in order in being called specially to consider a motion that would have come on the Agenda of the next Meeting, and that he was authorised by the planters of St. James and Trelawny to protest against the expenditure for the proposed Locked Still at Denbigh being paid from the funds of the Sugar Grant.

Mr. Cousins then gave full particulars as to the proposed Locked Still and submitted detailed plans and specifications, also estimates.

Mr. Calder protested against the manner in which the whole thing had been carried through and held that the experiment would be of no use whatever in checking the stealing of rum and he moved:

“That the Board acting under the powers conferred on it by Law 45, 1903 section 2, refuse to sanction any expenditure (for the purpose of erecting a Locked Still at Denbigh) of the funds placed under its disposal, until the plans and specifications have been submitted and approved by the Board.”

And he further moved the addition—“That the Board do not approve of the plans and specifications now submitted.”

Mr. Cork seconded.

The Archbishop said that there might be a way out of the difficulty if the expenditure could be shared equally between the Estate, General Revenue and the Sugar Grant.

The Chairman said that he could not agree to any charge on General Revenue.

The Chemist moved the following amendment:—

“That while this Board regrets that the full details of the installation of the Locked Still at Denbigh were not placed before them before the matter was put in hand, it is desirable, considering the expenditure already incurred, to proceed with the Locked Still at Denbigh and that the expenditure of £300 be authorised upon the estimates of the Sugar Fund for appliances and new apparatus for estates.”

On being put to the vote the Chairman, the Director of Public Gardens, the Chemist, and the Superintending Inspector of Schools voted for the amendment, and Hons. J. V. Calder and H. Cork for the motion. The Archbishop abstained from voting. The amendment was therefore carried, by four votes against two.

The Chemist asked for authority for the expenditure of £120 from the Sugar Industry Fund, for the Sugar Laboratory Buildings; £66 8s. for apparatus and gas box and for the experimental distillery; £104 2s. for a Chattanooga Cane Mill, a pair of Cuban steers, 36 puncheons, 36 Racking Cocks, Barrel on wheels and Hose; also £120 for alterations and new plant for Estate Distilleries in connection with the Locked Still at Denbigh. This was granted.

The usual Monthly Meeting of the Board of Agriculture was held on 15th November, 1904, Present: the Hon the Colonial Secretary, Chairman, the Director of Public Gardens, the Island Chemist, His Grace the Archbishop, the Hons. T. Capper, and H. Cork, Mr. C. A. T. Fursdon, and the Secretary, John Barclay.

Cattle Disease—The Secretary read a letter from the Colonial Secretary that His Excellency was considering the question of legislating with a view to the prevention of the spread of epidemic diseases amongst cattle in Jamaica.

Importation of Cattle—A letter from Mr. Fursdon was submitted with regard to the prohibition of the importation of cattle from South America. It was stated that there is a law providing for regulating importation and that a proclamation prohibiting the importation of cattle from Central and South America is in force, dated 5th August, 1896.

Cotton Conference—A letter was read from the Colonial Secretary enclosing copy of a letter from Sir D. Morris announcing a visit to Jamaica of Messrs. E. L. Oliver and R. Stancliffe, a deputation from the British Cotton Growing Association, and asking that any facts and figures available in reference to the Cotton Industry together with samples of cotton should be collected to be put before them.

It was resolved to hold a Cotton Conference at the Institute of Jamaica on 29th November, and the Secretary was asked to issue circulars to all who were interested in cotton, to notify the Agricultural Society and local Agricultural Societies, and to get notices inserted in the newspapers calling attention to this Conference. He was also asked to endeavour to get the particulars and samples desired.

Agricultural Conference at Trinidad—The Secretary read a letter from the Colonial Secretary enclosing copy of a letter from Sir D. Morris, asking the Government to send representatives to Trinidad to take part in the Agricultural Conference in January.

The Colonial Secretary stated that His Excellency proposed to send Mr. H. H. Cousins, and the Board was asked to nominate a practical agriculturist on behalf of the Board of Agriculture.

Mr. Cousins asked if he could be excused because his work in connection with the Sugar Experiment Station would be most important in January. The Chairman said he would refer the matter to the Governor.

The Secretary was instructed to ask Mr. Shore first if he would

act as the representative of the Board, and failing him Mr. Calder, Dr. Pringle or Mr. Cork. Mr. Cork promised to act if none of the three gentlemen named did so.

Tobacco—The Secretary submitted a report from the tobacco expert, Mr. F. V. Chalmers.

Water Buffalos—The Secretary read replies to his enquiries regarding the Water Buffalos—1 from the Department of Agriculture, U.S.A., with the information that the Water Buffalos were not in use in the United States, but were being used in the Hawaiian Islands on account of their value for work in wet and mud, in the cultivation of the rice fields; 2. from Mr. Meaden, Manager of the Government Stock Farm, Trinidad, giving particulars as to their use there and their cost, and giving reference to Mr. S. Henderson, Chaquanas, Trinidad, and Mr. B. de Lemarre, Orange Grove, Trinidad, who had herds of Buffalos. The Secretary was instructed to write these gentlemen for full information as to these animals and as to whether they could be procured in Trinidad and their cost.

Tourist Advertising Service—The Secretary submitted a letter from the Superintendent D. W. I. Cable Company, asking for a subscription to the Tourist Advertising Service. He was instructed to reply that the Board had no funds available for the purpose.

Chemist's Estimates—The Chemist submitted revised estimates of expenditure from the Sugar Industry Fund during the current financial year as follows:—

Authorised estimate 1904-5 ...	£1,400 0 0
Revised estimate for 1904-5 ...	1,055 16 8
·Saving estimated ...	£344 3 4

He also submitted a Statement showing that the Public Works having executed the Laboratory and Distillery buildings as one operation, it was not possible for the Treasury to keep the account, as originally authorised under two separate heads. He therefore asked for authority for a re-casting of the original items to meet this difficulty without affecting the total sum involved. The Archbishop proposed and it was agreed, Mr. Cork alone objecting, that the proposal be adopted. The estimate of capital expenditure under the Sugar Industry Fund now read

1. *Buildings*—Sugar Laboratory, Fermentation Laboratory and Experimental Distillery £1,000.
2. *Fittings and appliances*—Sugar Laboratory, Fermentation Laboratory and Experimental Distillery £1,000.

Of these sums the Director of Public Works was authorised to expend a sum not exceeding £1,000 on the construction account, while the £1,000 for fittings and appliances is authorised subject to the authority of the Chairman.

The Chemist also submitted the Estimates of expenditure for

1905-1906 showing a total of £1,400 as authorised in the Scheme approved by the Governor in Privy Council.

The Estimates of the Director of Public Gardens and of the Government Laboratory were submitted.

Reports from Mr. W. J. Thompson and Mr. E. Arnett with reference to School Gardens were submitted.

Cotton.—The Secretary read a report on the Cotton Experiments and asked that the balance of eight out of ten grants be authorised to be paid. This was approved of.

Agricultural Instructor.—A minute from Mr. Cradwick was submitted asking if he would be allowed to accompany the Cotton Experts if they visited St. Elizabeth where he could show them the various cotton cultivations. This was approved.

A letter from the Sav.-la-Mar Agricultural Society was submitted asking that Mr. Cradwick be permitted to act as Secretary of their Show under the special circumstances that no other experienced person was available this year. A minute was also submitted from Mr. Cradwick with reference to his acting as Secretary of a new Show to be held at Montpelier. It was agreed that Mr. Cradwick might act for this year, but that in future he is to consult the Board before undertaking such duties.

A letter from Mr. Cradwick was also submitted asking that he be allowed to change his residence from Ramble to Southfield so that he may give more attention to the cotton industry. It was pointed out that Southfield would be a most inconvenient centre for other parts of his district, and that it was 26 miles from the Railway. The proposed change was not therefore allowed.

Agricultural Education in Secondary Schools.—The Archbishop reported that the Standing Committee on Agricultural Education in Secondary Schools had met and that he would submit a report later.

Teachers' Course.—As regards the Teachers' Course at Hope Gardens and Mico College which was to commence on the 2nd January and last for four weeks, the Archbishop suggested that Mr. Fawcett form a Committee with Mr. McFarlane and Mr. Capper for carrying through the arrangements in connection with the Course. He asked that Mr. Fawcett would report at next Meeting. This was approved.

The following reports from the Chemist were submitted and directed to be circulated.

1. Progress Report—Field Experiments,
2. Arrangements with Estates for Sugar Laboratory.

The following reports from the Director of Public Gardens were submitted and directed to be circulated.

1. Mr. Cradwick's itinerary to the 23rd December and his visits for the month of October.
2. Hope Experiment Station.

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Part 3.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

C O N T E N T S :

	PAGE.
Citronella Grass in Ceylon ...	49
Halfway-Tree, Jamaica ...	50
Diseases of Coconuts ...	51
Experiments with Sugar Cane ...	52
Relation of Forests to Stream Flow ...	56
Culture of Ornamental and Flowering Shrubs and Climbers ...	65
Saffron ...	66
The Culture of the Central American Rubber Tree. VIII	67
Board of Agriculture ...	70

P R I C E—Threepence.

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CITRONELLA GRASS IN CEYLON.

Director, R. Botanic Gardens, Ceylon, to Director, Public Gardens and Plantations, Jamaica.

Peradeniya, 7th Dec. 1904.

DEAR SIR,

I see in your October Bulletin a reprint of Mr. Sawyer on Lemon and Citronella grasses from the *Chemist and Druggist*. Let me call your attention also to my reply in the same paper of 10th September. He is wrong about the Ceylon grasses, and it is difficult to hunt down an error that gets a start in a home paper, when one cannot reply in the next issue.

Yours faithfully,

JOHN C. WILLIS.

Director, R. Botanic Gardens, Ceylon, to Editor, Chemist and Druggist.

Peradeniya, 15th Aug., 1904.

SIR,

With reference to the interesting article by Mr. C. J. Sawyer, appearing on page 179 of your issue of July 30, 1904, permit me to make a few observations.

In the first place, Mr. Sawyer quotes the account of this grass in Trimen's "Handbook of the Flora of Ceylon," Vol. V., evidently under the impression that Dr. Trimen was the author of that volume. This is not the case; the late Dr. Trimen left no notes on grasses, and only a very poor collection in the herbarium at Peradeniya. Sir Joseph Hooker wrote the last two volumes of the "Flora" (see his remarks in the Preface to part IV), and is responsible for the statements there made: his account of the grasses is very incomplete in detail for the reason above explained. On page 180 Dr. Trimen is again used as an authority to dispute the

statement, which is perfectly correct, that there are two forms cultivated in Ceylon. This authority is, as shown, valueless; it rests only on the fact that our herbarium as sent to Sir J. D. Hooker contained only one specimen of citronella grass. I have devoted a good deal of attention to the citronella-oil question in recent years, and large plots of these grasses are now in cultivation on the Peradeniya Experiment Station. Full reports will be issued by this Department at a later date. In the mean time, let me assure you that there *are* two cultivated forms in Ceylon, called *Lena Batu* and *Maha Pangiri* respectively. A good account of them is given in Messrs. Schimmel & Co.'s "Semi-Annual Report" for October. 1898. *Lena Batu* is the form cultivated by the native growers, and furnishes practically all the exported oil. *Maha Pangiri* is the form cultivated by Messrs. Winter & Son at Baddegama, and gives a much finer oil, but needs more trouble in cultivation, having to be frequently replanted. The native prefers the *Lena Batu* because he does not need to replant it. He frequently abandons the cultivation when the grass is ten years old or more. The wild *Andropogon Nardus*, one of our most common grasses, is known to the Sinhalese as Mana, and is distinct from the cultivated forms; it yields a good oil, but the quantity is smaller. Lemon grass is also cultivated in Ceylon, and we have a considerable quantity of it upon the Experiment Station at Peradeniya.

I am, Sir,

Yours faithfully,

JOHN C. WILLIS.

THE HALFWAY-TREE JAMAICA.

By the late RICHARD HILL.

I visited Halfway Tree on Sunday the 25th November, 1866. When I first saw the cotton tree at the junction of the four roads through the plain of Liguanea from which Halfway Tree receives its name, it had nearly lived out its time. It was of that lofty straight stemmed variety of *Eriodendron* which originally growing among some clustering trees had overtopped them and had spread its horizontal arms out above them at about some fifty or sixty feet in elevation from the root. Four or five of these arms yet remained with a few scattery stems on which a few straggling leaves vegetated. An age of surface rains rushing to the sea three miles away, had removed all the soluble earth from the platform roots, so that they made arched resting places, where the marketers coming from the mountains would rest themselves in groups for they had reached the 'Halfway Tree'. The straight stemmed *Eriodendron* does not give one an idea of centuries of growth as the short wide-buttressed species,—if it be a species,—does, with its close-leaved hemispherical top, and a thousand feet

of circumferent shadow. The imposing majesty in the appearance of *this* tree, the ordinary silk-cotton tree of the open savannahs had led Indians and Africans to designate it the God-tree,—an epithet they do not use to the unbranched *Eriodendron*, though it may stand in solitary grandeur a hundred and twenty feet high. At the time of the conquest of the island two hundred years ago, the Halfway Tree was one of these tall solitary cotton trees of the Liguanea plain. Two hundred years more remote, the country was the home and inheritance of the Indians and the vertical moon saw these groups gathered beneath it at their midnight dances. The Halfway Tree ceased its associations with past and present history thirty years ago. (*Victoria Quarterly*, Oct., 1890.)

DISEASES OF COCONUTS.

The Director has examined from time to time all over the island reported cases of diseases of coconuts. In many instances the unhealthiness or death of trees was due simply to the unsuitable nature of the soil or climate. If the soil is a thick clay, or rocky, or very poor in plant food, or very dry, or liable to be saturated with standing water, the trees are never healthy, and when the conditions are more than usually unfavourable, they may succumb altogether. While in this unhealthy condition they are much more liable to the attacks of insect and fungous pests, and the immediate cause of death may be due to attacks which reach such vital parts as the terminal bud or the feeding roots.

But besides unhealthiness and death due to unfavourable conditions, there is a disease which attacks the flower parts and young nuts, sometimes spreading along the softer tissue, and at length reaching the terminal bud, causing the death of the tree.

Mr. Cradwick has been engaged at intervals during the last two years in applying various remedies suggested by me. These experiments are still in progress, but I may say that I find the most effectual remedy is to spray with Bordeaux Mixture at intervals of 6 to 9 months until there is no trace of disease. A spray pump is necessary, and even high trees can be sprayed by attaching a long hose to the pump, and sending a boy up with the nozzle, or even by tying it to the end of a long bamboo.

In Grand Cayman and in parts of Jamaica planters have not been successful in growing coconuts because the young plants die off just at the time of the first flowering. It is now hoped that with the use of Bordeaux Mixture, they will be able to grow them.

BORDEAUX MIXTURE.

Bordeaux Mixture is best made according to the following formula :—

Copper Sulphate	...	6 lbs.
Unslacked lime	...	4 lbs.
Water	...	50 gallons.

It requires careful mixing, or the ingredients will not combine properly. Put 25 gallons of water into a barrel, tie up 6 lbs. of

copper sulphate in a piece of coarse sacking, and hang this by a stick laid across the top of the barrel so as to be just beneath the surface of the water until it has slowly dissolved.

In another barrel slack 4 lbs. of lime very slowly and carefully, at first only adding about a quart of water at a time, until a perfectly smooth paste free from grit is obtained, add water to make the whole 25 gallons and wait until cool. Now pour both together into a cask holding 50 gallons. The milk of lime should be thoroughly stirred before pouring, and finally the mixture should be well stirred for 4 or 5 minutes with a wooden paddle. If not perfect, the mixture is liable to injure the foliage and in order to test this, put the blade of a penknife into the mixture and leave it for 1 or 2 minutes. If there is any deposit of copper on the blade showing a brownish colour, it is not safe to use it, and more lime must be added until the knife is not discoloured.

EXPERIMENTS WITH SUGAR CANE IN BRITISH GUIANA.

Notes of a paper by Prof. Harrison, read at the Agricultural Conference in Trinidad, January, 1905, on "Recent progress of agricultural experiments in British Guiana."

(a) *Older varieties of sugar cane.*—The results of 15 years experiments show that taking the yield of Bourbon as 100, the values of the better kinds were :—

White Transparent	...	100
Mani	...	100
Po-a-ole	...	98.5
Red Ribbon	...	94.4
&c.		&c.

None of these varieties on the large scale equal in productiveness the Bourbon, besides they have defects either from the cultural or the manufacturing point of view or from both.

Few of these varieties are now to be found in the colony. Against 65,608 acres of Bourbon in 1903-4 there were only 2,876 of White Transparent, and experiments with these varieties have now been discontinued.

(b) *Newer varieties raised from seed.*—In British Guiana we have raised about $\frac{1}{2}$ million of canes, and have selected some 26,000 for field experiments. Out of these we have selected a few hundreds for continued experiments, and from them the planters have selected a very few, say 50 varieties, as being possibly of value. Out of that 50, about one dozen show promise of being of actual value.

On an area of 35 acres preliminary small scale experiments are carried on, selecting the parent varieties first; then the vigorous seedlings; third culturally; fourth, analytically; fifth, repeating third and fourth methods with second and third ratoons; sixth, growing on plots of 1-20th acre under identical conditions, and then selecting about one-fourth of third or fourth ratoons; seven-

thly, several varieties of fifth and sixth selections will have been selected by planters by large-scale cultivation, and are now examined by manurial experiments.

The following shows the relative values up to third ratoons of the best of the varieties submitted to the sixth selection :—

No of variety.	Saccharose in expressed juice per acre of canes.	1900-1904.
		Indicated yields com- pare with Bourbon as 100.
147 B.	5.20 tons	175.7
145	5.11 "	172
625	4.99 "	168.2
115	4.74 "	160.5
1,087	4.70 "	157.4
109	4.66 "	157.3
74	4.63 "	154
2,468	4.11 "	137
2,190	4.10 "	136.7
1,640	4.05 "	135.9
3,157	4.05 "	135.9
132	4.03 "	134.4
2,028	3.98 "	133.9
1,896	3.97 "	132.9
1,880	3.96 "	131.3
116	3.78 "	127.5
130	3.72 "	126.8
135	3.72 "	125.2
754	3.60 "	123.8
102	3.37 "	123.2
117	3.19 "	113.
White Transparent	3.15 "	107.3
1,483	3.06 "	105.6
1,905	3.01 "	104.6
Bourbon	3.01 "	100.

The relative values of those of seventh selection are :—

D. 625	248.8
D. 116	219.1
D. 145	215.4
D. 130	202.
D. 109	195.1
D. 115	189.8
D. 78	189
D. 95	188.2
D. 74	184.5
D. 3,957	182.5
White Transparent	142.2
147 B.	124.4
Bourbon	100
D. 2,190	100

Experiments on Sugar Estates.—Small scale experiments on estates are not considered of any value, but experiments have been established under which only results obtained on not less than areas of one acre and repeated on not less than 6 estates are required.

Some results of these field trials showing yield and proportions of yields compared with those of Bourbon and of white Transparent taken as 100 :—

No of variety.	Tons commercial sugar per acre.	Bourbon=100.	W. Transparent= 100.
D. 625	2.58	137.2	150.
D. 95	2.06	111.2	121.5
Sealy	2.06	109.6	120
D. 145	1.99	105.8	115.7
D. 109	1.98	105.3	115.1
B. 147	1.93	102.6	112.2
Bourbon	1.88	100	109.4
D. 94	1.75	93.1	101.7
W. Transparent	1.72	91.5	100

Out of a total area of 78,468 acres under cane in 1903-1904, about 12,000 acres are under new seedling varieties. Of these the favourites are D. 109, B. 147, D. 145, D. 625, and B. 208.

In the selection of seedling varieties, more attention should be given to the size of the cane, number of shoots to the stool, and its ratooning power, rather than to its higher saccharine content.

The advantage of the seedlings most appreciated is that several yield remunerative crops where Bourbon will not now thrive.

Manurial Experiments.—Lime, 5 tons to acre, increases fertility of heavy clay-land in British Guiana. The excess yield upon limed plots in 9 crops amounted to 33 tons of canes on un-manured plots, and 35 tons on manured land.

Phosphates have as a rule exerted some effect when applied to plant canes, applying slag-phosphate at the rate of 900lb. per acre. Potash is not required.

Nitrogen—Results obtained over ten crops in 13 years indicate that every 10 lbs. of nitrogen in the form of sulphate of ammonia when added in proportions up to 300 lbs. per acre, give approximately 1.3 tons of canes, or say $2\frac{1}{2}$ cwts. of commercial (96 %) sugar. It is an easy matter to estimate knowing the prices of sulphate of ammonia and of sugar respectively, if manurings on land in good heart with sulphate of ammonia are likely or not to prove profitable. Similarly with nitrate of soda up to 250 lbs. each 10 lbs. of nitrogen gives 1.4 tons of canes, or $2\frac{1}{2}$ cwts. of sugar.

Experiments prove that all new varieties require manuring with nitrogen to give satisfactory results.

The nitrogen which accumulates in the upper layers of the soil

during long periods of forest growth or of fallowing, while the land is covered by dense growth of sedges, grasses and leguminous plants, suffers great and rapid losses when the soil is put under intensive sugar cane cultivation, and it is to the loss of the accumulated stores of readily available nitrogen that the marked falling off in the yield of canes per acre which is almost invariably noticed when successive crops are taken off from either new or from long rested soils is due. This loss is greatly diminished where very heavy dressings of farm-yard or pen manure are regularly used and upon very heavy clay soils the loss may be reduced to a minimum and an actual gain ensue. The loss is greater on soils manured with nitrate of soda, than when sulphate of ammonia is used; and is greater on limed, than on not-limed soils.

Whilst there was a loss of phosphoric acid, it appeared that cultural operations have made probably available more potash, and more lime, each year than is required for the growth of the sugar cane.

The following are the general deductions arrived at during these experiments:—

(1) Nitrogen in the form of sulphate of ammonia, of nitrate of soda, or raw guano, and of dried blood exerted a favourable influence upon the yield of the sugar-cane, and is the manurial constituent which mainly governs the yield of the plant.

(2) Dressings of from 2 to 3 cwt. of sulphate of ammonia per acre appear to be the most certainly profitable applications of nitrogen.

(3) The application of superphosphate of lime to plant-canes may give increased yields when added to manurings of nitrogen and potash, but ratoons should be manured with nitrogen only.

(4) Slag phosphate is preferable to superphosphate of lime, but the use of basic superphosphate is promising.

(5) The effect of lime, chiefly mechanical, in improving the texture of the soil, may be obtained perhaps at a lower cost by using light ploughs or other cultivators.

(6) The addition of phosphoric acid, of potash, or of lime, does not affect the sugar contents of the juice of canes. The effects of nitrogen retards ripening, and thus the juice is not so rich in saccharose as is that of canes grown without manure. But this is more than offset by the larger yield of produce.

(7) Mineral phosphates to give increased yields must be applied to the soil in such heavy dressings as to render their use unprofitable.

(8) The addition of potash exerts little or no effect.

The normal weathering of the constituents of the soil while under good tillage sets free for each crop potash in excess of the quantity necessary for the requirements for the plants. This holds good under the conditions existent in British Guiana where

the greater proportion of the potash taken up by the plants is directly returned to the soil, but where practically the whole of the produce is removed from the land it is probable that partial potash-exhaustion may take place in the course of a succession of crops of sugar cane.

Several of the new varieties appear to be able to utilise the nitrogen in the deeper layers of the soil to better advantage than the Bourbon cane does, and this is a matter of great importance with regard to the economical production of sugar from the sugar cane.

THE RELATION OF FORESTS TO STREAM FLOW.

By JAMES W. TOUMEY.*

Collaborator, Bureau of Forestry, U.S.A.

INTRODUCTION.

For the purpose of the present discussion "forest" must be understood to mean a growth of trees sufficiently dense to form a fairly unbroken canopy of tops, not a scattered growth of low, round-headed trees with bushes and herbage constituting the dominant types of vegetation.

Forests of this kind do not occur in the United States where the mean annual precipitation falls below 18 to 20 inches, except on restricted areas where unusual conditions prevail. The line of separation between the great eastern forest area and the plains approximately coincides with a north and south line marking a mean annual rainfall of 20 inches. The streams which rise in the Rocky Mountains and flow eastward are bordered by forests for long distances into the plains, where the annual rainfall is much less than 20 inches. These forests, however, are not so much a result of the rainfall in the regions where they occur as of surface and seepage flow from adjacent regions. The mesquite forests of the desert regions of southern Arizona, where the mean annual rainfall is but 8 to 12 inches, are made possibly by the seepage and surface waters from the adjacent mountains.

The question of the exact relation which exists between forests and stream flow has long been under discussion. The broad fact that a relation exists is indeed indisputable. Forest destruction always produces a change in the character of the run-off. But the scientific determination of all the causes which produce this effect, and of their relative importance is a difficult and complicated matter. In spite of the fact that for many years European forest experiment stations have been carrying on observations, mea-

* From "Yearbook of the U. States Department of Agriculture, 1903."

surements, and experiments designed to clear up this subject, final conclusions covering the whole field have not yet been established. In this country almost nothing has ever been done to secure accurate data for the investigation of this problem as a whole. Some light, however, has been thrown on the subject by means of a series of observations which have been going on for several years in the San Bernardino mountains in southern California. It is the purpose of the present article to make clear what are the various factors entering into the problem, and to state some of the more important facts that these observations in southern California reveal.

In the San Bernardino mountains records of precipitation for several years, at a large number of stations, show that differences in forest cover are closely correlated with differences in rainfall. This correlation is so close that it is possible to judge the mean annual precipitation with a fair degree of accuracy from the appearance of the forest alone. In these mountains forests cover the slopes wherever the mean annual rainfall exceeds 20 to 24 inches; however, on southern and western slopes forests of equal density represent a larger rainfall than on northern and eastern slopes.

Other things being equal, regions having the greatest rainfall bear forests of the greatest density and luxuriance of growth; but where the mean annual rainfall falls below 18 to 20 inches, types of vegetation in which trees predominate are replaced by those in which shrubs and herbage predominate.

WHAT CAUSES RAINFALL.

Because rainfall is most abundant where forests grow, many believe that forests exert an important influence on the amount of precipitation. A more reasonable inference, however, is that *rainfall is the great factor in controlling the distribution and density of forests.*

Precipitation occurs whenever the air is suddenly cooled below the dew-point. The most effective cause of this is the expansion of air in ascending. This upward movement is caused very largely by cyclonic storms.

Whether forests have any appreciable effect in cooling the air to below the dew-point is uncertain. From the known effect of forests on the temperature and relative humidity of the air, it is reasonable to infer that they may have some such effect, at least to a small degree, and consequently that they have some influence in increasing precipitation. The present evidence, however, derived from many series of observations conducted in Europe and elsewhere, is so conflicting that a definite answer to this question, having the stamp of scientific accuracy, is not possible.

WHAT BECOMES OF THE RAINFALL.

That the excessive destruction of forests is followed by the

drying up of streams and springs and by a diminution in the minimum flow of rivers is a well established fact. The forest is the most effective agent known in regulating the disposition of the precipitation after it reaches the ground.

Rainfall escapes from the ground upon which it falls in five ways—through evaporation, transpiration, surface run-off, seepage run-off and deep seepage. By evaporation is meant the moisture which passes into the atmosphere in the form of vapour from water and soil surfaces and from objects resting upon such surfaces, including vegetation. Transpiration is that portion of the rainfall which sinks into the soil, and which is later taken up by the vegetation through the roots and given off to the atmosphere through the stems and foliage. To this latter should be added, although not actually a part of it, the comparatively small amount of moisture taken up by the vegetation, but which through chemical change becomes a part of the organic vegetable structure. By surface or superficial run-off is meant that portion of the precipitation which, from the time of falling until its exit from the drainage basin, passes over the surface without gaining access to the soil. On the other hand, by seepage run-off is meant that portion of the rainfall which sinks into the earth, but which later reappears on the surface at lower elevations, and with the surface run-off escapes from the drainage basin in the streams. By deep seepage is meant that portion of the precipitation which sinks into the soil, but to such depths that it does not reappear later on the surface of the drainage basin.

Evaporation and transpiration are frequently classed together as evaporation. In the irrigated parts of the West they are together known as "fly-off". So, also, the rainfall which does not escape through evaporation and transpiration or through deep seepage is often classed as run-off or stream flow.

DO FORESTS INFLUENCE EVAPORATION ?

In order that the moisture which falls to the earth in the form of rain and snow should be most efficient in sustaining vegetation and in feeding streams, as little as possible should escape in the form of evaporation. Under the best of conditions a very large part of the annual rainfall is returned to the atmosphere through evaporation. For humid regions, bearing the same types of vegetation, the amount does not vary much from year to year, no matter what the fluctuations in rainfall are—a fact first made known by Messrs. Lawes, Gilbert and Barrington in the classical Rothamsted investigations. These gentlemen explain this persistency in the rate of evaporation by the fact that heat and abundant rain seldom occur at the same time. Consequently, in a wet season, the lower temperature and more or less saturated atmosphere prevent excessive evaporation; while in a dry season, although the temperature is higher and the air drier, there is less water to evaporate, and the two extreme conditions balance each

other so far as the amount of evaporation is considered. This is not true, however, in arid and sub-arid regions, because during years of minimum rainfall the upper layers of the soil are often so dry for months at a time that there is very little moisture to evaporate, while on the other hand during years of maximum precipitation the atmosphere is not sufficiently saturated to check rapid evaporation.

There is little or no difference between evaporation from a water surface and from any other surface that is thoroughly wet, when both are exposed to the same atmospheric conditions. The evaporation from a water surface is, however, always the same under the same conditions, but it is not the same from other surfaces, because they vary from completely wet to completely dry.

In the forest the crowns of the trees remain wet but a short time after precipitation. During this period, however, the evaporation is undoubtedly very rapid, on account of the large surface and from the fact that the crowns are exposed to the wind and sun. But in a long series of investigations made at the Forest Experiment Station at Nancy, France, and recently published, it was found that a deciduous forest near that station held back from the ground less than 8 per cent. of the total precipitation. Although this is almost immediately returned to the atmosphere in the form of evaporation, it is a comparatively small amount of the annual rainfall. On the other hand, evaporation from the soil in the open and in the forest continues often for long periods after the precipitation ceases. After the crowns become dry, evaporation is much retarded in the forest, because the forest floor is protected from the wind and sun. To such an extent is this true that the loss of moisture through evaporation is much less than that lost from an equally saturated soil or from a water surface in the open. Repeated European observations, extending over long periods of time and shorter observations made in this country, conclusively show that evaporation from water or other wet surfaces on the floor of the forest is but one-third or one-fourth that from similar surfaces in the open. From the investigations of the moisture content of soils in the San Bernardino Mountains, the results of which are as yet unpublished, it appears that the first foot in depth of the mineral soil in the forest may contain two or three times as much moisture as soil of the same general character from similar situations in the open.

During the summer it is impossible to determine by actual measurement the loss of water from the soil either in the forest or in the open, because conditions as to the moisture content constantly vary. During the winter, however, the evaporation from a snow surface can be measured with a fair degree of accuracy. Measurements made in the San Bernardino Mountains show that evaporation from snow surfaces may be four or five times as great as from water surfaces under similar exposure, and also that the rate

of snow evaporation is profoundly influenced by the wind. In our western mountains, where the snows are exposed to dry winds, the loss through evaporation is a large percentage of the total snowfall. In the San Bernardino Mountains, snowfalls a foot in depth are sometimes evaporated in two or three days without even moistening the soil. In so far as forests check the winter winds and provide shade, they lessen winter evaporation. This lessening of the evaporation from snow surfaces, through the action of forests, is seen in the fact that snows linger much later in spring in well-wooded regions than in open areas.

It appears, then, that forests materially retard evaporation, both of soil moisture and of snow fall.

DO FORESTS INFLUENCE TRANSPIRATION?

When land is covered with vegetation a certain amount of the rainfall is taken up by the growing plants. A small part, through chemical change, becomes incorporated into the plant, but the larger part is returned to the atmosphere through transpiration. Although those who have investigated this subject are by no means in accord, there is reason to believe that considerable difference exists in the amount of water taken up by the different types of vegetation in the process of growth. On the whole, the forest probably takes up less water from the soil than the average agricultural crop. Risler, from a lengthy series of investigations, reached the conclusion that forests actually take up less than one-half as much water from the soil as the average agricultural crop.

The above would lead one to infer that where the soil, if not covered with forest growth, is clothed with grass or some other low form of vegetation, the return of moisture to the atmosphere, through evaporation and transpiration, or, in other words, the "fly-off," is less from the forest than from the open. But in regions having a short wet season followed by a long dry one the return of moisture to the atmosphere is probably greater from a forested area, because in the open for a large part of the year there is very little to evaporate, and the scanty growth of grass and other low forms of vegetation gives little opportunity for loss through transpiration.

THE INFLUENCE OF FORESTS IN REGULATING THE RUN-OFF.

Stream flow consists of both surface run-off and seepage run-off. Although these two cannot be separately determined, total run-off admits of accurate measurement. Surface run off may be considered as flood water, while seepage run-off is that portion of the drainage which gives the streams a sustained flow. It is evident that any factor which decreases the surface or superficial run-off and increases the seepage run-off is of the utmost importance in regulating the flow of streams.

The proportion of flood water to seepage is influenced by the rapidity of the rainfall. It is well known from direct observation that a slowly falling, prolonged rain, even on the naked soil of steep slopes, is all taken up by the soil. On the other hand, a heavy shower of short duration, falling on the same slope, may largely escape as run-off. In the first instance each drop has time to be absorbed by the soil, while in the latter the accumulation of drops is more rapid than the absorption, and the excess moves over the surface to lower elevations. The forest canopy very perceptibly extends the period of time during which the rain reaches the soil, and in this way lessens surface run-off.

Again, forests, by checking the velocity of wind and covering the mineral soil with a thick layer of dead leaves and other forest litter, effectively prevent soil transportation by both wind and water. On high elevations, where streams generally have their birth, the influence of the forest in this respect is of the utmost importance. So great is this influence that it exerts a marked effect upon topography. In mountainous regions particularly, the repeated destruction of forests permits the soil formed by the decomposition of the rocks at the sources of streams to be transported to lower elevations, with a consequent slow change in the details of the landscape. Such regions, if unforested, are apt to have precipitous slopes and scanty soil on the higher elevations. In that case there is no adequate medium to absorb the rain, and it flows over the surface. On the other hand, if such regions are well wooded, the slopes are less precipitous, and a considerable depth of soil usually covers the broad summits. As a result, the rain water is absorbed and the surface flow is reduced to a minimum.

Not only is it essential to have an adequate medium present to absorb the rain, but it must be of such a character as to absorb quickly. The rapidity with which rain is absorbed is very largely governed by the physical properties of the soil, the organic litter upon it, and the vegetation. Decayed organic matter, by itself or in combination with mineral soil, absorbs moisture much more rapidly than soil containing little or no organic matter; hence, the greater the amount of leaf mould and other litter, the more rapidly will the rain be absorbed. Rapidity of absorption is also influenced by the degree of looseness of the mineral soil. In the forest the mulch of leaves and litter keeps the mineral soil loose and in the best condition for rapid absorption.

Not all the rain that is not absorbed by the soil where it falls reaches the streams by flowing over the surface. Much of it is taken up in passing from the place of falling to the stream. The amount taken up depends upon the obstructions in its pathway. Where there are no obstacles, as on barren ground, the moving water, by eroding channels, forms small rivulets, and these larger and larger ones, which flow with constantly increasing

velocity. As a result, the water passes rapidly over the surface, and but little gets into the soil. When the soil is covered with obstructions, such as are offered by a forest with its accumulation of litter and vegetable growth, the rain which is not immediately absorbed is checked in its flow over the surface. The water, being held back, is finally taken up by the soil and thus prevented from forming small rivulets through erosive action.

The forest, in extending the time during which the rain reaches the soil, in its effect upon local topography, and in supplying a larger and better absorbing medium, must necessarily have a profound influence in increasing the seepage run-off, and in proportionately decreasing the surface flow.

COMPARISON OF RUN-OFF FROM FORESTED AND NONFORESTED AREAS.

There are so many complex conditions influencing the flow of streams that it is extremely difficult to determine the effect of forests on run-off by the comparison of the discharge of streams on forested and nonforested catchment areas. It is believed by many that stream flow is so largely influenced by the amount intensity, and character of the precipitation, the configuration and area of the catchment basin, the character of the absorbing medium and the underlying rocks, and the general climate, as well as the forest itself, that we shall probably never be able to measure quantitatively the influence of forests on the flow of streams by the comparison of forested and nonforested regions. Catchment areas differ so greatly in the features mentioned above that our most conservative and able investigators have been forced to the conclusion that "in respect to run-off, each stream is a law unto itself." Although the above is probably in the main true, yet, by the careful selection of small catchment basins for comparison, it appears that the influence of the forest in diminishing the surface run-off can be determined with a fair degree of accuracy. When the catchment areas compared are in the same region, are influenced by the same or nearly the same climate and precipitation and by the same storms, have approximately the same configuration and area, and have a similar mineral soil and underlying rocks, the effect of these various factors on the run-off can be ignored, and the differences in the behaviour of the stream flow on the forested and nonforested areas can be assigned to the influence of the forest.

In a careful study of the behaviour of the stream flow on several small catchment areas in the San Bernardino Mountains, it has been found that the effect of the forest in decreasing surface flow on small catchment basins is enormous, as shown in the following tables, where three well-timbered areas are compared with a non-timbered one :

Precipitation and run-off during December, 1899

Area of catchment basin.	Condition as to cover.	Precipitation.	Run-off per square miles.	Run-off in percentage of precipitation.
Sq. miles.		Inches.	Acre-feet.	Per cent.
0.70	Forested ...	19+	36—	3
1.05	do. ...	19+	73+	6
1.47	do. ...	19+	70—	6
.53	Nonforested ...	13—	312+	40

At the beginning of the rainy season, in early December, the soil on all four of these basins was very dry as a result of the long dry season. The accumulation of litter, duff, humus, and soil on the forest-covered catchment areas absorbed 95 per cent, of the unusually large precipitation. On the nonforested area only 60 per cent. of the precipitation was absorbed, although the rainfall was much less.

Rainfall and run-off during January, February, and March, 1900.

Area of catchment basin.	Condition as to cover.	Precipitation.	Run-off per square mile.	Run-off in percentage of precipitation.
Sq. miles.		Inches.	Acre-feet.	Per cent.
0.70	Forested ...	24	452	35
1.05	do. ...	24	428	33
1.47	do. ...	24	557	43
.53	Nonforested ...	16	828	95

The most striking feature of this table as compared with the previous one is the uniformly large run-off as compared with the rainfall. This clearly shows the enormous amount of water taken up by a dry soil, either forested or nonforested, as compared with one already nearly filled to saturation. During the three months here noted, on the forested basins about three-eighths of the rainfall appeared in the run off, while on the nonforested area nineteen-twentieths appeared in the run off.

Rapidity of decrease in run-off after the close of the rainy season.

Area of catchment basin.	Condition as to cover.	Precipitation.	April run-off per sq. mile.	May run-off per sq. mile.	June run-off per sq. mile.
Sq. miles.		Inches.	Acre—feet.	Acre—feet.	Acre—feet.
0.70	Forested	1.6	153—	66—	25—
1.05	do. ..	1.6	146—	70	30—
1.47	do. ...	1.6	166	74	30
.53	Nonforested ...	1	56	2—	0

The above table clearly shows the importance of forests in sustaining the flow of mountain streams. The three forested catchment areas, which, during December, experienced a run-off of but 5 per cent, of the heavy precipitation for that month, and which during January, February, and March of the following year had a run-off of approximately 37 per cent. of the total precipitation, experienced a well sustained stream flow three months after the close of the rainy season. The nonforested catchment area, which during December, experienced a run-off of 40 per cent. of the rainfall, and which during the three following months had a run-off of 95 per cent. of the precipitation, experienced a run-off in April (per square mile) of less than one-third of that from the forested catchment areas, and in June the flow from the nonforested area had ceased altogether.

DO FORESTS INCREASE THE RUN-OFF ?

Owing to the very complex nature of the investigation involved in determining the effect of forests on the amount of run-off, the available evidence does not admit a definite answer that will be of general application. It is reasonably certain from present evidence that in some regions the effect of the forest is materially to increase the run-off. It appears equally certain, however, that in other regions, and on certain classes of catchment areas, the effect of the forest is to materially decrease the stream flow

Mr. Rafter, in his recent publication, "Relation of rainfall to run-off," makes this statement: "With similar rainfalls, two streams, one in a region having dense primeval forests, the other in a region wholly or partially deforested, will show different run-off. The one with the dense forest will show a larger run-off than the stream in the deforested area." This author concludes, from the careful study of a large number of catchment areas in the State of New York, that the effect of the forest on at least a portion of the area studied is to increase the run-off to an amount equal to from 5 to 6 inches in depth over the entire catchment area.

In humid regions, where the precipitation is fairly evenly distributed over the year, and where the catchment area is sufficiently large to permit the greater part of the seepage to enter the stream above the point where it is gauged, the evidence accumulated to date indicates that stream flow is materially increased by the presence of forests.

In regions characterized by a short wet season and a long dry one, as in southern California and many other portions of the West, present evidence indicates, at least on small mountainous catchment areas, that the forest very materially decreases the total amount of run-off.

Annual rainfall and run-off on forested and nonforested catchment areas in the San Bernardino Mountains, California.

Area of catchment Basin.	Condition as to cover.	Precipitation.	Run-off per sq. mile.	Run-off in percentage of precipitation.
Sq. miles.		Inches.	Acre—feet.	Per cent.
0.70	Forested	46	731	28
1.05	do. ...	46	736	30
1.47	do. ...	46	904	36
.53	Nonforested ...	33	1,192	69

On small nonforested catchment areas in the West, and possibly on large ones as well, a very large part of the heavy precipitation of the rainy season flows over the surface, quickly reaches the stream, and is discharged from the catchment area as flood water, much as water escapes from the roof of a building. On such areas the actual loss through evaporation during the dry season is probably far less than from a well-wooded area, because the surface soil and streams are dry, and there is very little moisture left to evaporate. On such denuded areas it appears that the run-off for the few months that the streams flow is considerably larger than that for the entire year from similar forested areas. Although a nonforested area may, in certain instances, produce a larger run-off than a forested one, this probably never occurs except when the run-off from the nonforested area is largely flood water, and of destructive rather than constructive significance.

CONCLUSION.

In conclusion, it may be said that although the forest may have, on the whole, but little appreciable effect in increasing the rainfall and the annual run-off, its economic importance in regulating the flow of streams is beyond computation. The great indirect value of the forest is the effect which it has in preventing wind and water erosion, thus allowing the soil on hills and mountains to remain where it is formed, and in other ways providing an adequate absorbing medium at the sources of the water courses of the country. It is the amount of water that passes into the soil, not the amount of rainfall, that makes a region garden or desert.

CULTURE OF ORNAMENTAL AND FLOWERING SHRUBS AND CLIMBERS.

By WILLIAM J. THOMPSON, F.R.H.S. Travelling Instructor, and Superintendent, Kingston Public Garden.

It should be remembered that when plants of this class are put out, it is usually intended that they are to remain in the same posi-

tion for a long time. This being so, care should be taken to see that the land they are to be planted in is deeply cultivated—that is to say, holes should be dug to a depth of about two feet, and from three to four feet across: the same soil should be put back in each hole with a half barrel of rotten manure, or succulent weeds may be mixed with the soil, and in planting, the base of the plant should be placed so that when the soil has settled down, it will be at least three inches below the surface of the surrounding ground. By paying attention to this simple rule, the shrubs or climbers planted will not need half the water and attention if the base of the plant is placed on a level with the surrounding ground, or a little above it.

The shrubs or climbers having been planted, it is of great importance that each plant is given about four gallons of water, to settle the soil about their roots and to start them growing. This copious watering at the time of planting is of the greatest importance.

Beyond watering and keeping clean, the plants will not need any special attention until they are beginning to outgrow the space allotted to them.

When it becomes necessary to prune the plants, it should be done just as they have finished flowering and before they begin to start into growth again.

If the plants are attacked by scale insects it will be an indication that they are getting in poor condition, and the most effective and least expensive way of improving their condition will be to prune them back to within about eighteen inches of the ground, and have the soil about the roots cultivated to about fifteen inches deep, and from a foot to three feet wide. In doing this be careful not to disturb the soil within a radius of twelve inches of the stem of each plant. All roots met with in carrying out this cultivation may be cut away without any harm being done to the plants. When the cultivation has been carried out, that is the same soil and a little manure put back into the trench, a few gallons of water should be given each plant.

To some people the above may seem an expensive way of cultivating; but I can assure them, that it gives the best results in the long run.

SAFFRON.

Crocus sativus is a light-purple autumnal-flowering species. It yields the saffron of the shops, which consists of the deep, orange-coloured stigmas of the flowers gathered with part of the style and carefully dried. A grain of good commercial saffron is said to contain the stigmas and styles of nine flowers, and consequently 4,320 flowers are required to yield one ounce of saffron.

The flowers appear in the late autumn. Though termed perennial, it must be remembered that each corm, which may be regarded as a joint of a short vertical rhizome, has but a duration of two years.

The mode of collection and preparation of saffron *varies somewhat in different countries, although in all it consists essentially in removing the stigmas with the upper part of the style from the other parts of the flower, and afterwards drying the parts thus detached. In France, the flowers are gathered at the end of September or the beginning of October, after which the stigmas with the end of the style, are quickly removed; and these parts are then immediately dried on sieves over a gentle fire, the drying process only taking half an hour. In the Abruzzi, the gathering takes place in the early morning, at the latter part of October and during the whole of November. The collectors are chiefly women, who are furnished for the purpose with wicker baskets, which they place on their arms, and as they pass along the furrows left as pathways between the ridges of saffron plants, they pluck the whole flowers and place them in their baskets, in which they carry them home: the stigmas being removed afterwards at leisure, and then dried.

Saffron was formerly in great repute as a stimulant, antispasmodic, and emmenagogue; but at present it is scarcely ever employed for such purposes. Its chief use in medicine is as a colouring and flavouring agent. As a condiment it is, however, still much in use in various parts of the Continent, as in Austria, Germany, and Switzerland; and to some extent even in parts of Great Britain. In India saffron is extensively employed by the natives in their religious ceremonies, as also in medicine, and as a condimentary substance. Saffron is also used by bird fanciers, as they believe it assists the moulting of birds.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, VIII.†

(Continued from *Bulletin for February*.)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

CASTILLOA AS A SHADE TREE.

The substitution of *Castilloa* or other rubber-producing species for the unproductive shade trees commonly grown with coffee, cacao, and other tropical crops has been persistently advocated ever since the subject of rubber culture began to receive popular attention. The advantage of such a plan appears so obvious and

*See Bentley and Trimen's *Medicinal Plants*.

† Extract from the U. S. Department of Agriculture. Bull. No. 49, Bureau of Plant Industry.

certain that many experienced tropical agriculturists have been betrayed into direct and even emphatic statements for which the facts have unfortunately failed to provide a warrant. Indeed, it might be said that this phase of rubber culture affords the best illustration of the lack of definite knowledge which hinders practical progress.

In the first place, the shading of coffee and cacao is a subject upon which there is much popular misconception and difference of opinion, the planters of some regions shading heavily and those of others not at all, and explaining their methods by the most contradictory reasons.* It seems, however, that there is not the slightest reason to believe that either coffee or cacao is injured by standing in the sunlight, or is in any way advantaged by having its leaves shaded, though in countries subject to a long dry season the shading of the ground and the retention of atmospheric humidity may be beneficial cultural measures. That *Castilloa* is in no way adapted for serving these purposes is apparent as soon as it is known that wherever there is a distinct dry season the leaves fall off at exactly the time when they are most needed. It is true that they would still be of some service in covering the earth, but on the other hand, the loss of the accustomed shade renders the atmosphere much drier and may be a distinct injury to the coffee.

Not only does *Castilloa* thus lack the first qualification of a shade tree, but its cultural requirements and those of coffee are entirely at variance. *Castilloa* seems likely to produce rubber in paying quantities only at low elevations, while the profitable cultivation of coffee is seldom considered possible at an altitude of less than 1,000 feet. In elevated continuously humid coffee districts the rubber trees will hold their leaves but will produce little or no rubber, while to choose an intermediate situation would be more likely to insure two failures than to double the chances of success.

The suggestion of *Castilloa* for cacao shade is somewhat more rational, since both trees are natives of the same regions of low elevation. As noted elsewhere, rubber was first planted at Tapachula as shade for cacao, but the experiment did not appear promising from the standpoint of the cacao, and was abandoned. Some of the cacao trees still remain, but they have never been vigorous and produce very little. Other causes of failure may, of course, exist, but it seems certain that the close planting which is now favoured would make a rubber plantation a very poor place for cacao, and there is every reason to believe that, while cacao may not be benefited by shade, it may be seriously injured by sudden exposure to the sun, as happens when the leaves of *Castilloa* fall in the dry season.

A further difficulty in the use of *Castilloa* as shade is that in

* These have been discussed in some detail in Bulletin No. 25, Division of Botany, U. S. Department of Agriculture, entitled "Shade in Coffee Culture." Also see Bulletin of the Department of Agriculture, Jamaica, June and July, 1903.

order to permit anything to grow under it, wide planting is necessary, and this usually means a spreading low growth for the rubber trees, generally considered undesirable, because it makes the extraction of rubber difficult if it does not actually decrease the yield.

Vanilla culture under *Castilloa* has also been suggested, and may be worthy of consideration, since it is held that a period of dryness and exposure to the sun is necessary for the proper ripening of the pods. To successfully combine two or three cultures is, however, a difficult matter, even when all are well known, but the supposed practicability of such combinations has rested on ignorance of important details.

Several years ago the culture of *Castilloa* received a considerable impetus from the recommendation of Dr. Daniel Morris, now Imperial Commissioner of Agriculture for the British West Indies, that *Castilloa* be used as shade for coffee and cacao in British Honduras, and an estimated return was made of \$5 per tree in eight or ten years, or \$125 per acre, to be repeated at intervals of five years.

According to Dr. Carl Sapper, a German scientist very familiar with Central America, this advice has been followed with disastrous results. He says :

In fact, the developments thus far in the field of *Castilloa* culture show on the average very little in the way of favourable results. Particularly does it seem to have failed completely when it has been combined with other tree cultures in order to lessen the expenses of opening rubber plantations. Thus, on the advice of the well-known English botanist, D. Morris (then in Jamaica), rubber trees were planted for shade in the coffee plantation San Felipe, near El Cayo, in British Honduras, and the result was that these shade trees ruined the coffee, but did not on the other hand themselves develop normally, because they were planted too close. In other places, as in Tabasco, in the Department of Pichucaleo, in Chiapas, and in Chamá (Department of Alta Verapaz, Guatemala) rubber trees were used for shade on cacao plantations, but the cacao planters tell me that the trees impair the growth of the cacao and do further damage through the falling of the leaves, so that they would much prefer to be rid of these shade trees if that were practicable. In other instances, where the tree was planted by itself, too close an arrangement was chosen, so that the trees were impeded in development, and are still after 12 years of existence mere tall, slender, unproductive poles, as at Los Amates, Department Izabal, Guatemala, with only four yards of space." *

It seems, however that Dr. Morris has a favourable report regarding *Castilloa* as a shade tree for cacao, both in British Honduras and in the West Indies, and his former advice was repeated before the Agricultural Conference of the West Indies in 1901. He said :

In 1883 I published an account of the *Castilloa* rubber tree of British Honduras and the manner of extracting and curing the rubber. At that time I recommended that the tree might be used as shade trees for cacao. A trial was made sixteen years ago on a cacao plantation on the Settee River, and I learn from a letter from the Superintendent of the botanic garden at Belize, dated November 8 last, that the rubber trees have answered admirably for this purpose. He writes : "At Kendal on the Settee River the cacao plantations are thriving well. * * * Cas-

* Der Tropenpflanzer.

tilloa was planted for shade ; these are also in good condition ; * * * * there is not a better tree for that purpose." I am glad to find that similar results are reported from Trinidad and Tobago.*

The report from Tobago, to which Dr. Morris refers, is particularly enthusiastic, and seems to indicate that under the conditions existing on that island the planting of Castilloa with cacao may not be inadvisable :

I find that cacao bears very well under the shade of Castilloa. Nine years ago I planted an acre of rubber and cacao together—the rubbers at 24 feet apart and the cacao 12 feet—and so far as I have noticed there is very little, if any difference, in the bearing of these cacao trees and those under the shade of the *Bois immortel*. On finding this, I planted last year 15 acres in the same manner, and there is every reason to expect that in another eight or nine years they will give a gross return of about 50 pounds per acre. Coffee also bears well under *Castilloa*.†

The difference between Castilloa and leguminous shade trees may become apparent in later years as the nitrogenous constituents of the soil become exhausted. As explained elsewhere, the question is not whether Castilloa can be used as a shade tree, but whether it will be productive where it is of use in this capacity.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 10th January, 1905. Present: the Hon. the Colonial Secretary, presiding, Mr. Wm. Harris, Acting Director of Public Gardens; the Island Chemist; His Grace the Archbishop, the Hon. T. Capper, Messrs. C. A. T. Fursdon, C. E. deMercado and the Secretary, John Barclay.

Trade Marks—With regard to the Colonial Secretary's letter re the amendment of the section 25 of Law 31 of 1903, concerning Trade Marks, after discussion it was resolved to reply to the Colonial Secretary that the Board feared that the proposed amendment would serve little useful purpose, because it could be so easily evaded, as trade marks could be taken out in other names, and used by an exporter.

The Secretary was also instructed to say that the members of a former committee which had considered the whole matter of the orange industry had been asked for their opinions, and six were in favour of the proposed amendment and four against it.

Sugar Industry Fund—The Secretary submitted a letter from the Acting Treasurer, showing statement of the Board's account with the Treasury in the matter of the Sugar Industry Fund up to 30th September, 1904, and showing as receipt in addition to the £1,000 Imperial Grant interest on loans to sugar planters amounting to £400 13s., making a total of £10,400 13s., and payments

* West Indian Bulletin, 2 : 113, 1901.

† West Indian Bulletin, 2 : 111, 1901.

amounting to £830 5s. 6d., leaving a balance of £9,570 7s. 6d. A receipt was asked for from the Board as a final discharge to the amount shown as payment, and the Chairman was asked to give the necessary receipt, after the statement had been checked by the Chemist.

Shows—A letter from Mr. Cradwick to the Director of Public Gardens was submitted, stating that as the Montpelier Show had been put forward to the 23rd March, instead of the 24th May, he asked to be allowed to postpone his visit to Portland until April, instead of March, so that he might act as secretary to the Show.

This was agreed to.

Water Buffalo—The Secretary submitted a letter from Mr. S. Henderson, Woodford Lodge, Trinidad, giving the details asked for regarding water buffalo cattle, saying that he would have much pleasure in taking the representatives from Jamaica at the Agricultural Conference in Trinidad to see his cattle.

The Secretary was instructed to publish the information contained in this letter and what might be received from Mr. Fawcett and Mr. Williams.

Ramie—A letter was submitted from the Hon. H. Cork, addressed to the chairman, stating that he was informed that there was now a market for ramie fibre in Holland, which merely required that the material be sent in a dried state, and asking that information be obtained on the subject.

Blood from Slaughter House—The letter also asked that the matter of utilizing the blood at the Slaughter House and the city refuse as manure be considered.

The Chemist stated that the city refuse was only worth 12/6 per ton as a manure.

Chemist's Reports—The Chemist submitted his reports as follows :

1. Sugar Industry Funds—Financial details of the locked still experiment, showing an increase on the £300 estimated of £49 16s. 11d., and asking that the Board pass revised estimates of £355 to allow of a margin for contingencies.

This was agreed to, Mr. deMercado dissenting asking that his protest against the whole scheme be again noted, seeing that the Board had not authorized the scheme before it was commenced, and that it was subsequently approved only by a majority consisting of official members.

2. Financial details of new building at Laboratory, showing that the Public Works Department had expended £959 13s, a saving of £40 upon the £1,000 authorized. Statement of account with reference to the fittings and equipment of the Laboratory, showing an estimated liability of £808 12s. 10d. on the authorised expenditure of £1,000 leaving an estimated balance of £191 7s. 2d., and asking for authority to spend £154 as per further details submitted, which would leave a balance of £37. The Board agreed to

the expenditure, with the express understanding that these estimates should not be exceeded.

3. Standardization of Jamaica Rum—This was directed to be circulated.

4. Proposed legal standard for milk—giving details of the analyses of the milk of 92 Jamaica cows, and suggesting the adoption of the following standard for Jamaica: total solids, 12 per cent.; solids, not fat, $8\frac{1}{2}$ per cent.; fat, $3\frac{1}{4}$ per cent. This was directed to be circulated for the remarks of the Board.

5. Application for admission as agricultural students by H. L. Forbes, Kingston, S. M. Daley, Stony Hill, L. A. Cooke, Kingston, and P. L. Irving, Deeside. It was agreed to admit the first three, and admission of the fourth (Irving) was left to the Chairman, when the Chemist submitted satisfactory particulars as to his means.

6. Progress Report, Sugar Department—This was directed to be circulated.

7. Details Diploma Examination—These were directed to be circulated.

The Acting Director of Public Gardens submitted reports as follows :—

1. Mr. Palache on School Gardens in Manchester.

2. Re cocoa trees dying in St. Mary—The Secretary was instructed to write cocoa planters in Highgate and Troja and get all the details he could, and ask Mr. Cradwick to make enquiry into the matter when he went to St. Mary in February.

3. Work of Hope Experiment Station—These three reports were directed to be circulated.

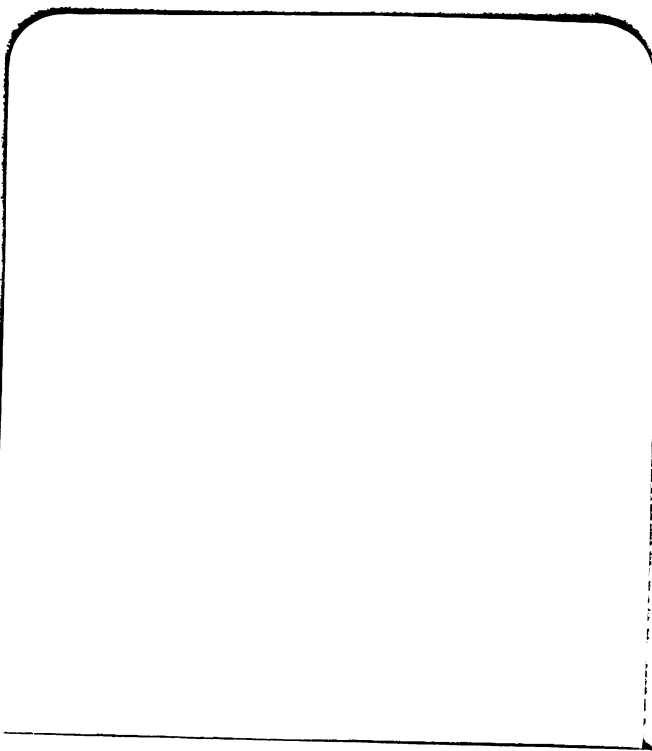
4. Letter from the Board of Trade, Commercial Department, London, with reference to the report by Mr. F. V. Chalmers, and asking for samples of tobacco to be sent them.

The Acting Director of Public Gardens was instructed to send the samples asked for.

The Acting Director of Public Gardens reported that he had now two crops of tobacco in store, amounting to over a ton, and asked for instructions as to what price he should accept for it. On the motion of the Archbishop, the Department was authorized to dispose of the tobacco as best they could.

[Issued 18th March, 1905.]

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